Marine Engineering

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PATENT OFFICE

STEAM YACHT HELENITA.

One of the handsomest new yachts to enter this season's fleet is the *Helenita,* 185 feet length over all, built for Mr. Frank J. Gould by the Gas Engine & Power Company and Chas. L. Seabury & Company, Consolidated, Morris Heights, New York City. The yacht is of steel throughout, and, as seen in the accompanying drawing, has very graceful lines.

The keel is of bar steel and the stern post and stem are of forged steel; the frames and reverse frames are of angle steel spaced 21-inch centres. The plating is laid in inside and outside strakes, with the horizontal seams lapped and the vertical seams fitted with butt straps. There are five water-tight steel bulkheads extending to the main deck, viz., the forward collision bulkhead, the forward boiler room bulkhead, the one between engine and boiler room, the after engine room bulkhead, and the after collision bulkhead. Bunkers with the capacity of 90 tons of coal extend athwartship at either end of the boiler room, and wing bunkers are placed on either side. The rudder is of the steel plate type.

The bulwarks of the vessel are of steel, carried up 22 inches above the deck from the bow to the stern, and are topped by a teak rail. The deck is laid with white pine and is fitted with the necessary chocks, cleats, etc. On the forecastle are a steam windlass and two Herreshoff anchors. The two pole masts and the spars are of Oregon pine, and, according to the latest design, no gaffs are fitted. For sails the yacht carries one foresail, mainsail, and jib. A complete set of awnings are stretched from polished brass stanchions placed alongside the bulwarks.

As seen from the drawings, there are two deck houses, one forward and one aft, both of which are built of mahogany. At the forward end of the forward deck house is a large dining saloon furnished very handsomely in mahogany and inlaid trimmings. Aft of the dining saloon is the pantry, and next is the smoking room, open on either side to the deck and also connecting with the dining room by a passageway. The joiner work of the smoking room is of quartered oak, with paneled oak ceiling, and the walls are inset with paintings of marine scenes. Aft of the smoking room, on the starboard side, is the captain's state room, and on the other side is a deck room. The top of the deck house is covered with canvas and a wooden grating, and over it an awning is stretched. The officers' bridge is aft of and raised above this deck, and extends from side to side of the vessel. Here are placed the steering wheel and the engine room telegraph pedestal. A chain from the steering wheel connects with the steam steering engine in the engine room.

NEW STEAM YACHT HELENITA.

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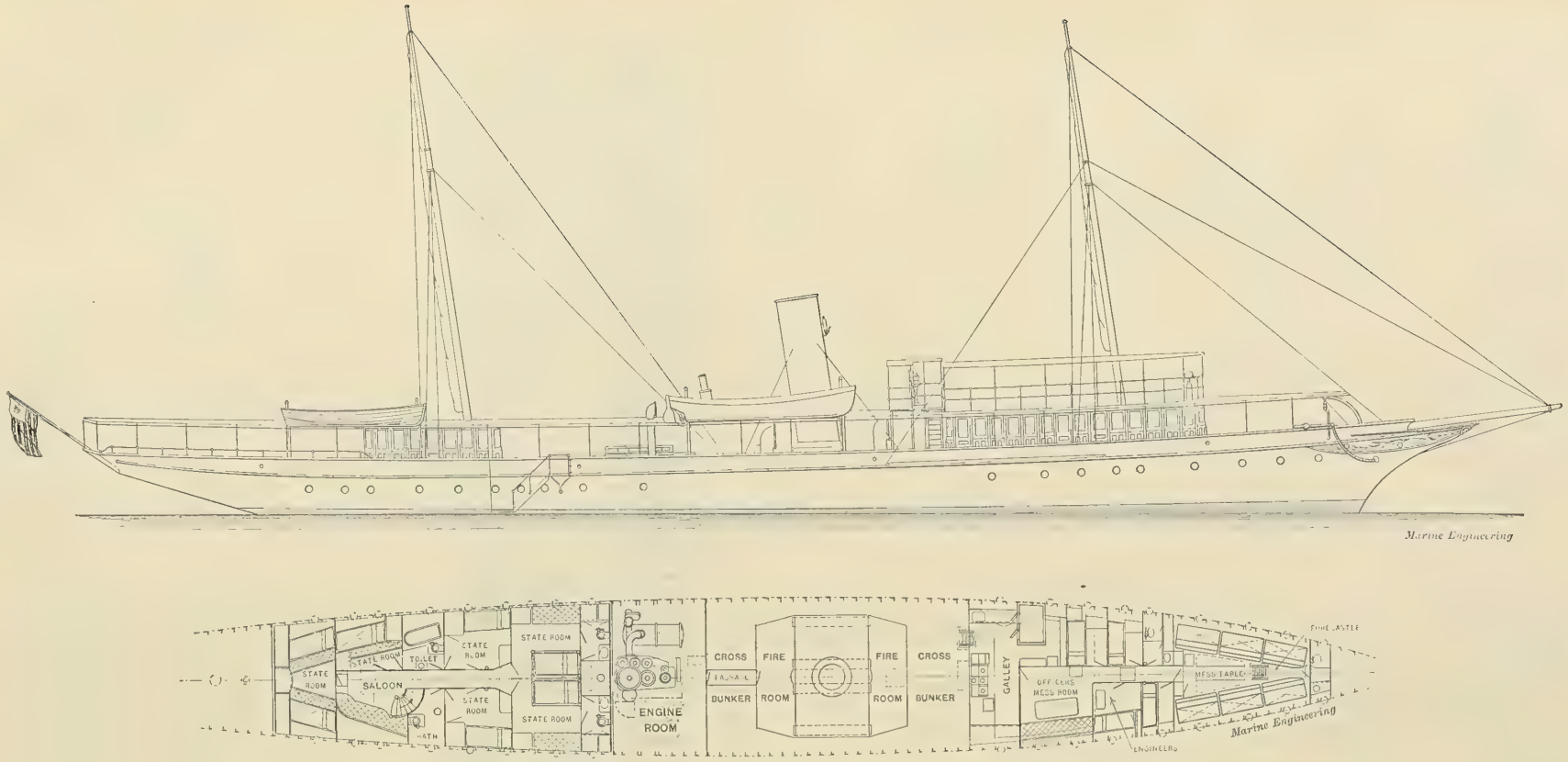


OUTBOARD PROFILE AND CABIN PLAN OF THE HELENITA, BUILT AT MORRIS HEIGHTS, NEW YORK.

A steel trunk extends the full length of the boiler and engine rooms, and is trimmed with mahogany. Large mahogany skylights and companionways open from the top of this trunk. The after deck house contains one large room, viz., the social hall. The joiner work of this room is especially elaborate in carved work, the wood being beautifully grained Cuban mahogany, while the pieces of stationary furniture are made of similar material.

Returning to the bow, and descending the crews' companionway, are found, first, the chain locker, boatswain's locker, the crew's toilet room, and the forecastle containing 18 folding pipe berths. Aft of the forecastle are the officers' quarters. There are two state rooms on the starboard side, a large one for the chief engineer, and a smaller one. On the port side are two state rooms with two berths each, and the toilet room. Aft of the chief engineer's room is the officers' mess. These various rooms are reached through a passageway running amidships fore and aft by a companion ladder from the deck above, located just aft of the forward deck house. Aft of the mess room is a large galley extending from side to side of the ship, and on the port side are refrigerators and store rooms. All of these forward quarters are finished in white pine highly polished.

Passing now to the after deck house, a stairway leads below deck to the owner's quarters. Against the engine-room bulkhead are two large toilet rooms extending the full width of the vessel. These serve the double purpose of deadening the noise of machinery from the owner's quarters, which are directly aft and open into the toilet rooms. There are two large equal-sized bed rooms for the owner, with a portable screen bulkhead,

which may be easily removed and the two rooms thrown into one. The cabinet work of these quarters is of bird's-eye maple and very handsome. On either side of the passageway leading from these apartments are guests' state rooms and a large toilet room.

In the lazarette at the stern is the usual place for stowing lines, etc., and there is also a series of racks for storage batteries.

In the boiler room are placed two Seabury double-end boilers, each one containing 840 one-inch tubes, and doors open conveniently from the coal bunkers to the boiler room floor at either end. Fan blowers are located in the top of the boiler trunk, one for each boiler room, for supplying forced draft. The vessel is propelled by a Seabury triple expansion engine of dimensions given in the following table. The design of the Seabury engine is generally well known, but a brief mention of it may be appropriate. The valves, which are of the piston type, are all at the side of th engine opposite the cylinders, and are operated through connecting rods by a valve crank shaft extending parallel to the main crank shaft. This valve shaft is driven by gears from the main shaft through an idler, and this crank shaft can be so set in reference to the main shaft as to give ahead or stern motion. The crank shafts and valve shafts are cut from solid steel stock of best quality; the connecting rods, piston rods, and valve rods are forged from best steel stock. All crank shaft bearings are extra large, and are lined with close-grained babbitt metal; all other bearings are made from fine quality of composition bearing metal. The pistons are of steel, and are accurately fitted with spring rings which are self-adjusting, while piston valves are used with an approved and simple valve motion, having few parts to wear. All bearings are provided with ready means for taking up slack due to wear. Crosshead guides are of fine-grained cast iron. The cylinders are attached to the cast steel bed plate by forged steel stanchions, properly braced, and the crosshead guides are bolted to the rear stanchions; the crosshead is of the slipper type.

A complete set of auxiliaries is installed, including three duplex feed pumps, circulating pump, sanitary pumps, bilge pumps, ash chute, etc. The electric lighting plant consists of one 125 16-C. P. dynamo, a 2,500-C. P. searchlight, and storage battery sufficient for operating 25 16-C. P. lamps for 10½ hours.

A set of four handsomely finished mahogany carvel-built boats are swung from davits. The owner's launch is 26 feet long, built of mahogany, and driven by a 6-H. P. naphtha engine. The gig is also mahogany, 20 feet long, and the 20-foot cutter is of the same material. The crew's launch is 21 feet long and driven by a 2-H. P. naphtha engine.

On the trial, recently conducted, a speed of 19.46 miles per hour was maintained for two consecutive hours. As the season approaches, this handsome craft will no doubt attract more and more attention because of her graceful lines, speed, and comprehensive design.

Length over all, 185 feet.
Length on water line, 150 feet.
Beam, molded, 22 feet.
Depth, molded, 72 feet.
Draft, 9 feet.
Coal bunker capacity, 90 tons.
Water in tanks, 10,000 gallons.
Engine, 1 Seabury.
Type, 3 cylinder triple.
Cylinder, diameter, 13½, 21, 34 inches.
Stroke, 21 inches.
Speed, 19.46.
Valves, all piston.
Boilers, number, 2.
Type, Seabury.
G. S. total, 95.82 square feet.
H. S. total, 3,748 square feet.
Draft, closed stoke hole.
H. S. ÷ G. S., 39.

Turbine Reciprocating Engine-Driven Vessel.

On February 11 the destroyer *Velox* was launched from the yard of Hawthorne, Leslie and Company. The new vessel is of the same type as the unfortunate *Viper* and *Cobra,* and will be driven by Parson's turbines. Special attention has been paid to the conditions necessary to secure longitudinal strength. A novel feature in this vessel is the introduction of ordinary reciprocating engines fitted in conjunction with the steam turbines and coupled direct to the main turbines, working in conjunction with them. They take steam directly from the boilers and exhaust through the high pressure turbine, the exhaust from the latter passing in turn through the low pressure turbine and thus to the condensers. These reciprocating engines are for use at cruising speed when low power only is needed. When turbines are run slowly they show very low efficiency, and as the destroyers travel usually at cruising speed the Admiralty decided to place reciprocating engines in them for this service.

When the highest speeds are required steam will be shut off entirely from the reciprocating engines, which will be thrown out of gear and the steam turbines alone used. The boilers are of the Yarrow type. The vessel is of the usual size of destroyers, viz.: 210 feet long, 21 feet wide, 12 feet 6 inches molded depth, but has not been built to the order of any government.

Fast Steamboat.—The new steamer *William G. Payne,* built by the Harlan and Hollingsworth Company, of Wilmington, Del., is reported to have steamed at the rate of 21.95 knots over the Government course in the Delaware.

A Fast Trip.—The steamship *American,* of the American-Hawaiian Steamship Company, recently made a record trip from New York to San Francisco, completing the passage in 59 days and 20 hours from Sandy Hook to San Francisco lightship. The course was 13,555 nautical miles. The above time includes three stoppages in the Straits of Magellan, on account of the days being so short there at present, and 18 hours for loading coal at two ports. The longest stretch of straight steaming without closing the throttle was 28 days. The average boiler pressure was 180 pounds and the horse power 1,957.38; the number of revolutions per minute, 58.6; and the average coal consumed per day, 39.3. The engines have cylinders 28, 48, and 75 inches in diameter by 48 inches stroke, and are equipped with Marshall valve gear.

STEAMBOAT BUILDING UNDER DIFFICULTIES.

BY EDWIN B. SADTLER.

The building of a modern steel steam vessel is a work of considerable magnitude at any time, and becomes one requiring an unusual amount of thought and continual close application to the details when it has to be done in a place remote from a shipyard and its appliances.

The purpose of this article is to describe the building of the hull of the new steamer *Sagamore,* which has been constructed on the shores of Lake George, in the village of Caldwell.

templates were made showing the room allowed. One of these templates was erected at each end of the car while loading, and care taken that nothing should extend above a line drawn from one template to the other.

The material for the steel hull and the ship carpenter work, together with the necessary tools for erecting and riveting the vessel, filled fifteen cars and weighed over six hundred thousand pounds. To insure a delivery of all the materials at one time, the whole fifteen cars were shipped on one train; but, as it seemed to better suit the convenience of the railroads, they arrived in three lots of five, seven, and three cars respectively,

VIEWS SHOWING THE VARIOUS STAGES OF CONSTRUCTION OF THE SAGAMORE, BUILT ON LAKE GEORGE.

The material for this boat was gotten out, worked, and temporarily erected at Wilmington, Del., after which it was carefully marked, taken apart, and loaded on cars for shipment.

Troubles caused by the weather began while loading the cars, as, a few days before this work was completed, a snowstorm came which covered up many of the small parts lying about and caused some anxiety lest anything should be overlooked. Great care had to be taken that no piece should be so large that when loaded on the cars it would exceed the dimensions, height or width, given by the railroads, in order to pass through their tunnels. To insure safety on this point, wooden

after a journey, in the shortest instance, of six days. As might be expected, the undesired happened, and the car containing the part wanted first, that is, the keel, arrived last.

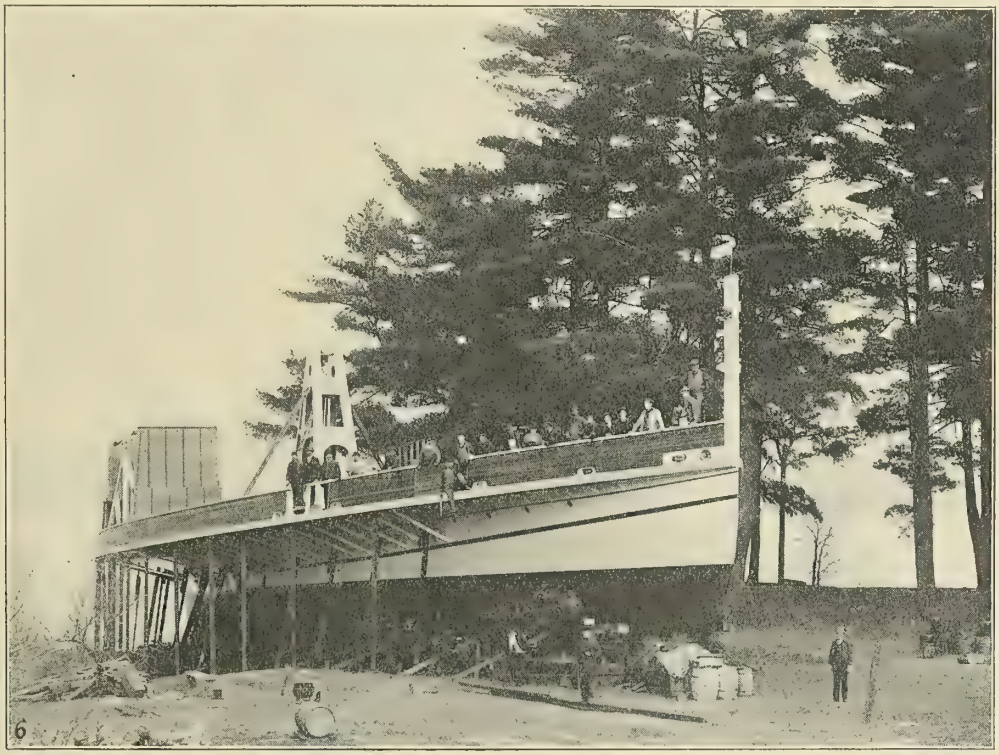
As soon, however, as the first shipment arrived the transporting of the material from the train to the place of erection, which we will call, for convenience, the yard, began. The unloading of parts so large and heavy without any cranes made it necessary to erect temporary sheer poles from which to hoist the material out of the cars for loading on the sleighs which were to convey the material to the yard.

Strangely and appropriately it occurred that this boat

with its Indian name had the first piece of actual work done at the place of building by an Indian of the "Abnakis" (called O-bin-I-kee) tribe. Although the frames were not the heaviest part to be transported, they were the bulkiest, and in order to hoist them out of the cars two sheer poles were erected at either end of the car which was being unloaded. Most of the cars used were of the gondola type, with sides about 7 1-2 feet high. However, for some of the frames a 50-ton coal car was used, one end of the frames resting in the pocket of the car. This necessitated an unusually great hoist of about 22 feet in all. After the frames were hoisted out of the cars, they were skidded down to sleds placed on the ice alongside of the wharf on which the cars were unloaded.

hill on the port side, it was necessary to place most of the material on the slope of ground ahead of the boat. This general layout is shown in Fig. 1, taken at the end of the first week's work. When the material was located the snow was so deep that blocks of wood and logs had to be placed under the piles to keep them above the snow and ground, for fear of freezing fast. In order to facilitate the stacking and finding of the material, that for the starboard side was painted red and that for the port side brown. This was found to be of the greatest assistance for quickly locating any part.

On March 3, 1902, the first instalment of mechanics from the home yard, eighteen in number, was set to work. At about 10 A.M. we began to arrange the keel blocks, which constituted the first actual work of con-



THE SAGAMORE, ERECTED ON THE SHORE OF LAKE GEORGE IN SEVEN WEEKS.

In order that the sheer poles might be guyed first over the cars, then toward the edge of the wharf, it was necessary to run guys out over and fasten them in the ice. This was done by cutting holes through the ice and putting toggles below with lashings around them, to which the guys were made fast. This caused considerable trouble, as the ice was about 30 inches thick at this place.

After the material had been unloaded and hauled across the lake to the yard, a distance of about a third of a mile, it had to be taken ashore and arranged with great care and very systematically, in order that when wanted it could be found with the greatest ease, and also with a view of handling it as little as possible when it was wanted in the construction.

Owing to the fact that there was just about the width of the boat's hull of flat ground sloping away into a swamp on the starboard side and rising suddenly to a

struction. These blocks had been put in place some time previous, but, fearing that the water might not be deep enough to launch the boat from the chosen spot, we bored the ice at intervals and sounded the lake. The depths found showed our fears to be correct, so we moved the blocks further down, making due allowance for the expected rise in the level of the water due to the melting of the snow on the surrounding mountains. Having located our blocks, we stretched our line, fitted the top blocks to it, and then proceeded to lay the keel. By 6 P.M. of the first day we had landed on the blocks all of the keel but the extreme end sheets, which we kept down until ready to raise the stem and stern post.

The following day we replaced in position the garboard strake, raised two midship frames, and proceeded to "horn" or square in all directions so that the other frames might be regulated by them. Having our trial frame erected and squared, we then began erection in

earnest. As the space where the boat was built was so narrow, the frames were either laid on the banks of snow cleared from under the boat or spread around the field ahead of the boat, and required several men for handling. As each frame weighed nearly a thousand pounds (the web frames being much heavier), and as the ground was very rough and uneven, this proved slow work. The frames were skidded over the ground under their proper position, raised bodily up and placed on the keel, and then erected in place by the use of a block and fall made fast to the beam end of the previously erected frame.

Shortly after noon on the third working day, after we had gotten well started on the frames, it began to snow in the neighboring mountains, and, seeing that we were also in for it, the boys were put at work gathering up all loose bolts, nuts, washers, and small tools that would likely be shoveled or swept away by clearing off the snow. This storm left us an additional foot of snow to clear away next morning before we could proceed with the work.

As the men took great interest in the work, we succeeded in getting the first frames up the second working day. Further interest was encouraged by engaging a photographer to take weekly pictures showing the progress of the work, and then making a point of getting certain parts ready for our next picture. The result of keeping the men in a good humor was that in fifty-two hours' actual working time we had every frame raised, including the stem, stern post, and transom, with all the cant frames and most of the ribbands in place. While we were rushing the frames other matters were not neglected, as we stopped raising them long enough to get all the long keelson and ridge bars inside of the boat while one end was open and we could drag them down over the snow and in endwise over a temporary incline.

As soon as the framing was completed we began to erect our staging around the boat, and here again we met trouble owing to the narrowness of our building ground. As the staging covered all the ground from well up on the hillside to the swamp on the other side, we had to arrange the cross space so that we could drag the shell plates and other materials down under them to their desired locations. This we found only possible on the low side, and hence had to resort to the use of a snatch block at the stern and a long line back to the bow to drag plates down on the uphill side. On the low side we found an apple tree actually coming under the guards of the boat. The owner of the land had made a special request that no harm be done to his trees, so we dug around its roots, and, attaching a fall to it with the other end fast to a convenient sheer pole, we pulled the tree out and laid it over in the swamp, where we carefully covered the roots with snow so that no harm might come to it.

The peculiar layout of the staging to suit our horse-power conveyer is shown in Fig. 2, which also represents the condition at the end of two weeks' work. Notwithstanding the interruptions occasioned by bad weather, we had quite a lot of the shell plating up and the guard started, as well as a good start made on the riveting.

In order to hurry the riveting, we held off the plates in line with the keelsons until the rivets at the back of the keelsons, generally known as "bumps," were all driven.

By referring to Figs. 3 and 4, taken on March 24, it will be seen that all the heavy work, except the gallows frame, was in place in just three weeks from the start. The shell plates were all up except the closers, which we kept off for ease of access and to clear out the snow from the hull when necessary, and there were about fifteen thousand rivets driven at this time. The guard, including wheel beams and guard logs, was all on except a few beams around the stern; the wooden stem was up, and the bow chock and piece of fender fitted; also quite a width of deck laid from the bow to the boiler hatch. The laid deck was all bolted and plugged, and quite a patch of it was calked.

As will be seen by Fig. 3, the lake was still covered with ice; in fact, this view shows several men at work on the ice removing some stones which were found, forming part of an old pier, just in line with the boat, and which would interfere with the safe launching of the vessel.

At this stage of the work, the heavy part being well advanced and having other matters on hand, the writer left for other scenes, leaving the work in charge of the efficient foreman carpenter, and the matter of time-keeping and paymaster's duties in the hands of another.

The good start we had made seemed to be the means of keeping things going at a lively rate, for at the end of four weeks the gallows frame and A-frames were up and the launching ways were being fitted.

On April 1, less than one calendar month from the actual start, the outside or shell gangs of riveters were sent home with their work complete, leaving only the inside men to finish up small work, the gallows frame, and wheel batteries. This work was all completed before the time set by the builders for launching.

The illustration on page 327 shows the hull completed and was taken on April 22, the day before the launching, or just seven weeks and one day from the laying of the keel blocks and keel. When the distance from shop conveniences and the weather conditions, together with the usual setbacks of a shipyard, are considered, this was undoubtedly very good progress in the construction of a 200-foot vessel having nearly fifty thousand rivets to drive, all by hand, and many of them in close and difficult places.

The illustrations for this article are from photographs taken by Mr. Henry Sisson, of Caldwell, N. Y.

New Type of Steamer.—The United States consul at Copenhagen states that a new type of ship is being built in that city, in which the screw is placed under the bottom and the bottom made flat.

Summer Schools.—The Dean of the College of Engineering of the University of Wisconsin announces that the second year of the summer school in the College of Engineering opens on June 30 and will continue until August 8, 1902. The primary object of the school is to give engineers, superintendents of power stations, and machinists, artisans, and apprentices of various trades, such mathematical, laboratory, and shop instruction as will be found of most practical value in the limited time of six weeks.

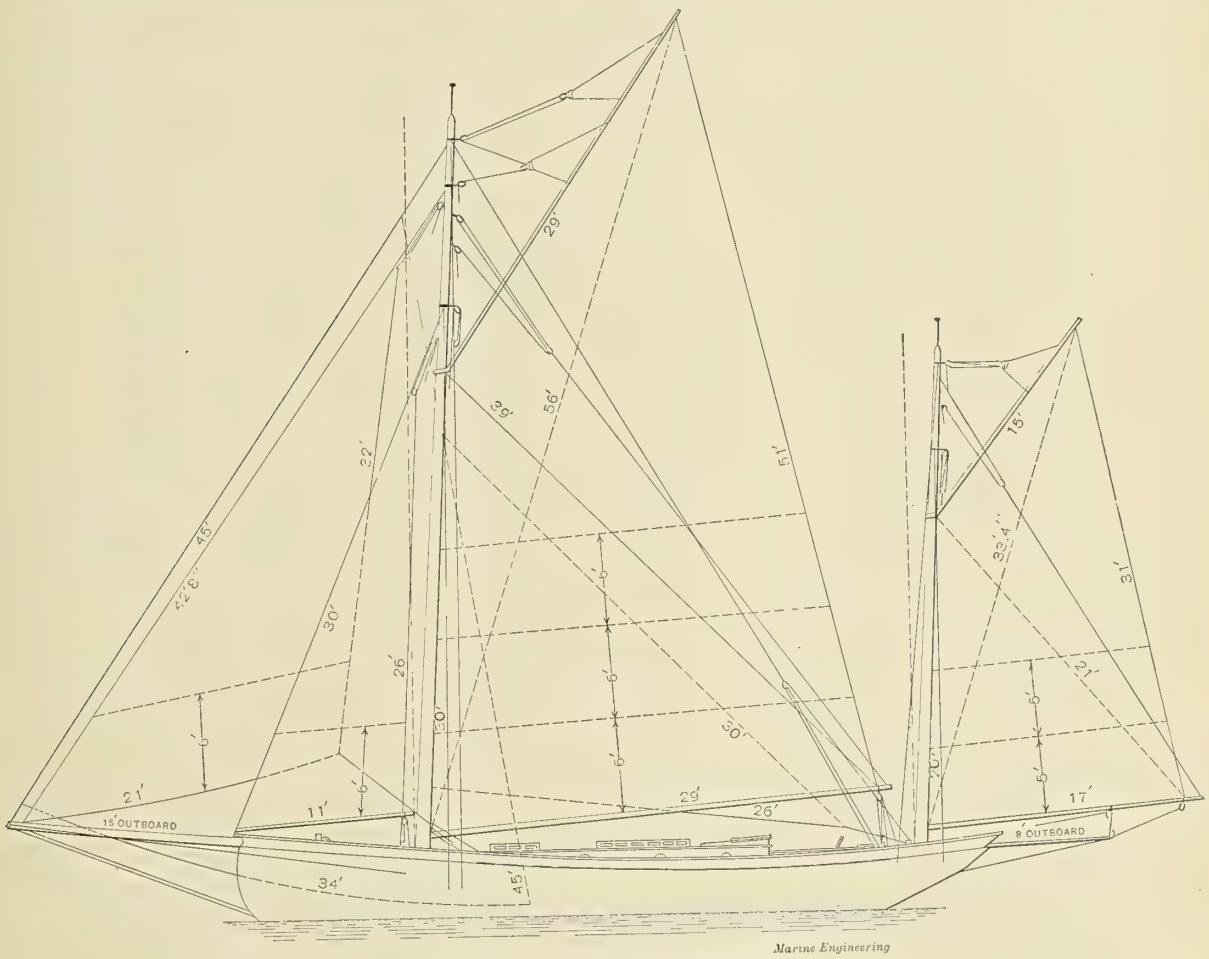
The Cruising Yawl Windward.

The *Windward* was designed for Mr. Francis A. Brown, of Marinette, Wis., by J. Byron Roney, of Lynn, Mass., for strictly cruising purposes, and is now enroled in the fleet of the Chicago Yacht Club. The requirements were for a cruising yawl to be as safe as possible and easy to be handled by a small crew in heavy weather, and to have good accommodations for her size. The limitations were to not exceed 50 feet in length or more than 6 feet draft, and to have full head room. Her owner expressly stipulated that she was not to have long overhangs, as he had seen and experienced enough of them on the rough water and steep seas of the Lakes; consequently she was given a plumb stem and short overhang aft with V-shaped archboard, thereby gaining much in easiness of entrance and inside accommodations over a craft of similar length with the long overhangs. She has been thoroughly tried by her owner, and has proved a very successful boat for what she was designed, and also fast in heavy weather.

The *Windward* is strongly, though not extra heavily, constructed. All framing and planking are of oak; the frames and deck beams are steam bent, and the deck is of pine, spars of spruce, and the cabin finished with hard woods and varnished. All ironwork is galvanized, and fittings and rigging are the best obtainable. The boat was built under the owner's personal supervision and the work was well done.

The general dimensions are:

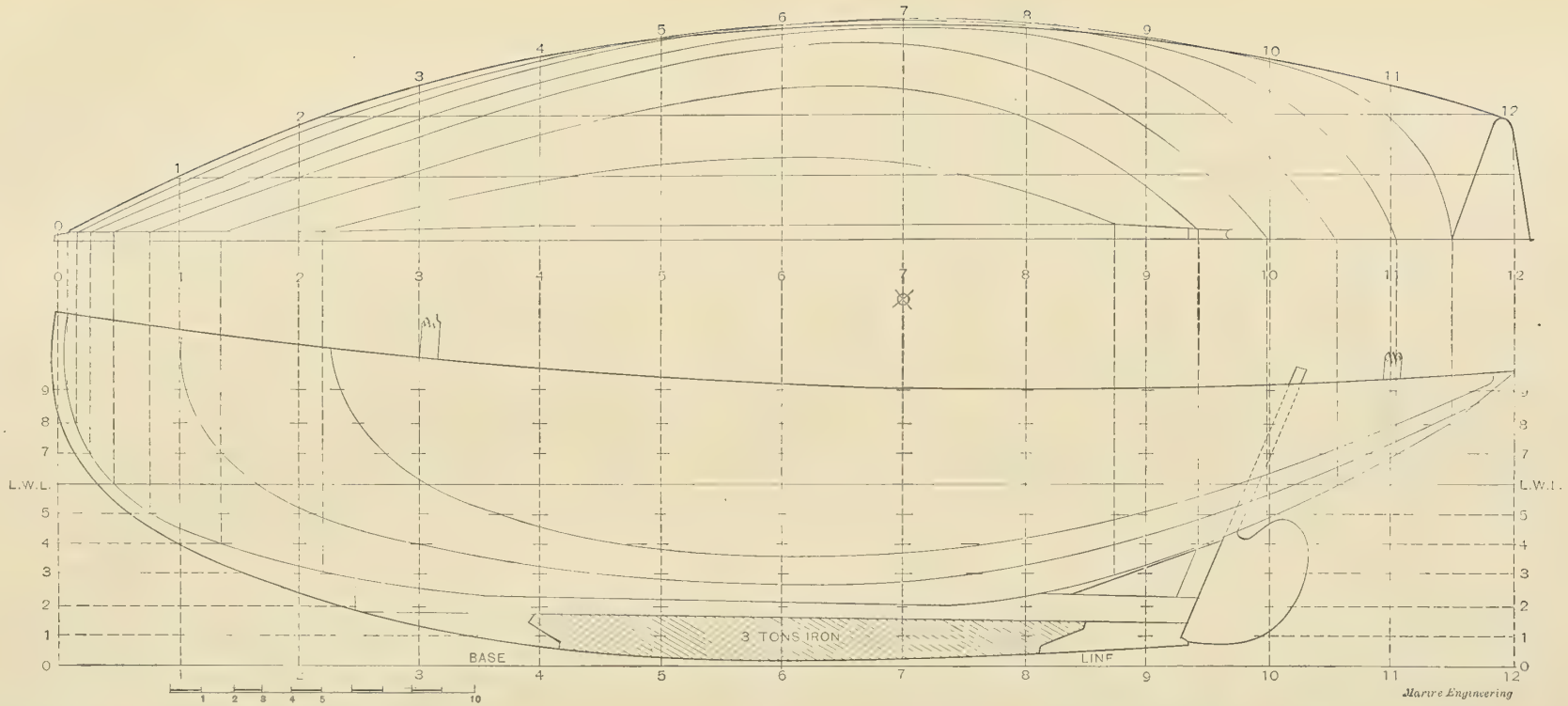
Length over all, 49 feet.
Length on water line, 41 feet.
Beam, 14 feet.
Depth of hold, 6 feet.
Draft, 5 feet 10 inches.
Freeboard at bow, 5 feet 8 inches.
Freeboard at stern, 3 feet 8 inches.
Head room, 6 feet 4 inches.
Length of mainmast from deck to cap band, 47 feet.
Length of mizzenmast from deck to cap band, 32 feet.



SAIL PLAN OF THE YAWL WINDWARD.

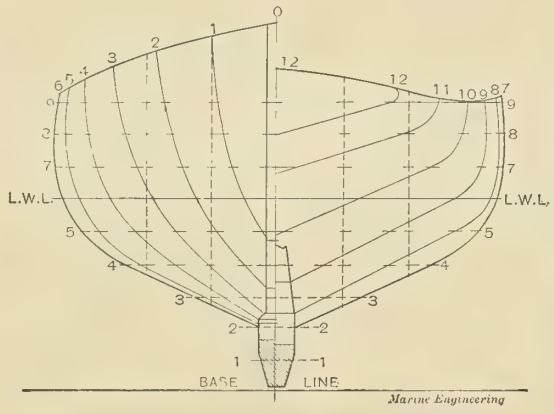
Length of main boom, 30 feet.
Length of main gaff, 30 feet.
Length of mizzen boom, 18 feet.
Length of mizzen gaff, 16 feet.
Length of forestaysail boom, 11 feet 6 inches.
Length of bowsprit outboard, 15 feet.
Length of bumkin outboard, 8 feet.

The scantlings are as follows: Keel, 10 by 12 inches; stem and stern post, sided, 6 inches; tail feather, a single oak stick reaching from keel to archboard about 8 by 10 inches, molded to conform to rabbet line; frames, 3 inches by 4 inches at heel, 2 1-2 inches by 3 inches at head, steam bent, spaced 12 inches on centres; floor timber, 3 inches by 4 inches, natural crooks; deck beams, 2



inches by 3 inches, except partner beams, which are 4 inches by 4 inches, spaced 20 inches on centres; keelson, 4 inches by 10 inches; king plank, 2 inches by 18 inches; clamp strake and bilge strake, 2 inches by 10 inches; shelf, 2 inches by 10 inches; sheer plank 2 by 8 inches, oak; deck laid parallel to sheer plank, 2 inches by 3 inches; cabin deck 1 1-2 inches by 4 inches; planking, 1 1-2 inches thick, oak; ceiling, 1 1-2 inches thick; cabin house, 21 feet long; bulwarks, 10 inches high; waist, 3 feet wide; outside ballast, iron, 3 tons; inside ballast, scrap iron bedded in cement; rudder post is of 3-inch steel shafting; the blade, 1-2 inch plate steel.

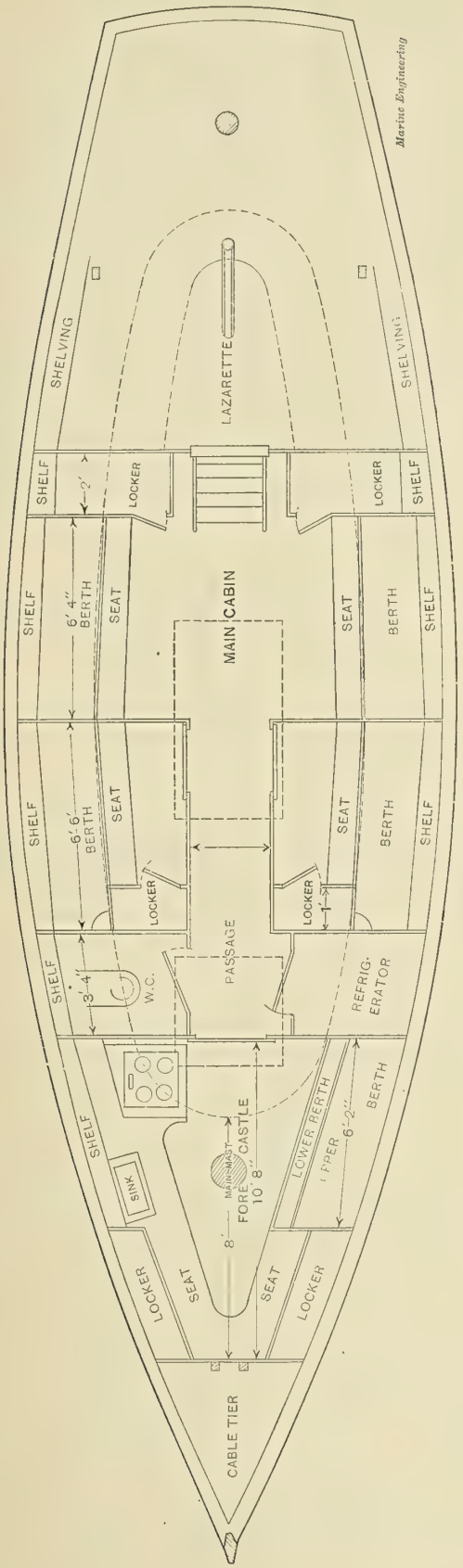
Berths and seats are fitted to use room beneath for storage purposes. Sleeping accommodations for ten people. An immense amount of room in lazarette for storage of spare sail rigging. There are portlights in



WATER LINES, BUTTOCKS, AND BODY PLAN OF YAWL.

side of house and ventilators in lockers. The skylights are respectively 6 feet by 3 feet 4 inches, and 3 feet by 3 feet 4 inches, and the fore hatch is 24 inches by 30 inches, giving good light and ventilation all through the cabin forecastle, state rooms, and toilet. The forecastle bulkhead being aft of forward end of house gives good head room and light to galley and allows heat from stove to readily escape.

The deck is carried in and makes the seats in cockpit, with washrail sprung around continuous with line of house. She is fitted with bronze hawse pipes and a suitable windlass, and carries three Baldt stockless anchors with chain and manila cable of good length. An Edson stearing gear is used. The standing rigging is of best steel wire, and the running rigging is of manila. The sails were made by Carpenter, of Chicago.



CABIN PLAN OF YAWL WINDWARD.

TAIL SHAFTING FOR MARINE ENGINES.

BY J. P. BADENHAUSEN.

The subject of Marine engine tail shafting is one which is of the most vital importance to those who put to sea in ships as well as to those who foot the repair bills.

MARINE ENGINEERING, in the issue of November, 1901, discusses the causes of breakage in propeller shafting, and divides these causes into three divisions, namely:

1. Poor material.
2. Unforeseen strains.
3. Corrosion.

1. POOR MATERIAL.

As far as poor material is concerned, ship owners and ship builders go only to reputable manufacturers of shafting who furnish certificates of inspection, with test pieces and guarantee shafting for 12 months

The material itself may be wrought iron or steel, and the preference of one over the other is governed by the price and the experience of the superintending engineer of the line for whom the vessel is to be built.

A wrought iron shaft has perhaps, structurally speaking, a superiority over the steel shaft. For the best wrought iron shafts, rods of iron are taken, one-half inch in diameter or one-half inch square, the rods being the length of the shaft. These rods are put together one upon the other, sufficient rods being used to make up the size of shaft, the rods being held together by bands of the same material; then the whole mass is raised to a welding heat and welded so as to form a solid homogeneous mass.

Here we have a shaft built up of rods running lengthwise, which means that the fibers of the material run in the same direction, and it is at once apparent that the flexibility of such a shaft is greater than that of a steel shaft due to the difference in structure. The strains upon a tail shaft are very severe, and when a shaft is forged from individual rods, as is the case with a wrought iron shaft, the tendency to break short off is less than if it were made of steel.

There is another point of apparent superiority of a wrought iron shaft over a steel one, which may be noticed when observing the effects of corrosion upon a wrought iron shaft and upon a steel one. It may then be noticed that the effect of the corrosion tends to manifest itself upon a wrought iron shaft by ridges which run lengthwise, while upon a steel shaft the effect is more commonly shown by eating in running around the shaft.

Since the strength of a shaft is given by its least diameter, the steel shaft loses more, since it is weakened circumferentially and not longitudinally.

2. UNIFORM STRAINS.

This has been fully discussed in the article above referred to in this magazine, and it is unnecessary here to go further into the question. One more point, however, may be mentioned, which, although a trivial one, has a tendency to further strain a shaft.

The stern bearing is usually bored out 1-16 inch to 3-32 inch larger than the diameter of the shaft. After a vessel has been running some time and is then docked and the shaft drawn in, it will be found that the stern

tube bearing is worn down more at the lower right hand quarter, if the engine turns a right hand propeller, than in any other part, and that the shaft works in the stern tube in an oval path instead of a circular one.

The abuse which a tail shaft receives while the vessel is driven through a head sea, and the straining caused thereby, are so severe and so diversified that the skill of the designer is set at naught, and the best mode of procedure is to follow the rules laid down by the classification societies, such rules being the expression of wide practical experience under all the varied conditions of service.

3. CORROSION.

This is, probably, the agent to which the failure of most shafts may be ascribed.

That corrosion may be reduced and even entirely eliminated, is possible, as the experience of the writer fully justifies. Careful design in many minor points, especially in preventing the actual contact of salt water with the shaft proper, may prolong the life of a tail shaft to that of the rest of the shafting or until some unforeseen accident puts an end to its usefulness.

pressure exerted by the shrinking on has been sufficient, in cases where common alloy was used, to split the liner from end to end.

Some manufacturers make it a point to hold the liner to the shaft, besides shrinking, by means of countersunk tap rivets. Why should these be used? In the opinion of the writer they are not only unnecessary, but are also conducive to great injury to the shaft.

The liner should be shrunk on tightly, and if this is done the rivets are unnecessary. If, perchance, the liner should become loose and the countersunk screw rivets are the only dependence for keeping shaft and liner together, then again great harm is done, since when the liner is loose the salt water will come between the shaft and liner and corrosion will begin, which is doubly dangerous since the action is going on underneath the liner where it is not to be seen. If a liner is loose, the sooner the looseness is remedied the better. Then again the holes which are drilled into a shaft for these screw rivets tend to weaken the shaft, and cracks may be started therefrom which would not have materialized if these holes had not been drilled.

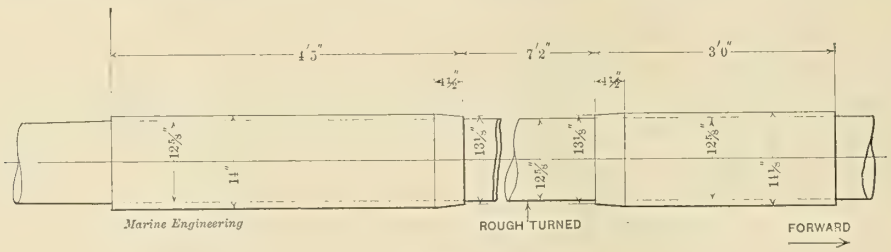


FIG. 1.

The considerations necessary to prolong the life of a tail shaft are as follows:

a. Periodic inspection.
b. Liner or liners.
c. Design of taper part of shaft.
d. Design of key.
e. Design of hub.
f. Nut and nut fastening.

a. Periodic Inspection.

Vessels are docked once or even twice every year for the purpose of cleaning and painting the hull, and for examining sea-connections. At least once a year the propeller nut and propeller are removed, the shaft is drawn in for inspection, the liners are tested with a sounding hammer, and that part of the shaft which is exposed to the action of the salt water and not protected by the liners is scaled, scraped clean and painted with anti-fouling composition.

The stern tube bearing is tested to see how much the shaft has worn down the lignum vitæ bearing, and if necessary, new wood is put into the tube.

b. Liner or Liners.

The main function of a liner is to provide a suitable bearing for the shaft, but the secondary one, that of protecting the shaft, is of no less importance. In most ships, say up to 2,500 tons, it is possible to use one liner which will extend from the propeller end of the shaft through the stern stuffing box gland. These liners must be made of especially good composition, since the

These single casting liners have been made to a length of 14 to 16 feet and even more, electrically heated, and shrunk on; but there is risk of getting a poor casting in such length, so that for cheapness usually two or more liners are used, especially when the distance from the stern frame to the stern gland is very long.

Fig. 1 shows a shaft having two liners, the intermediate part being the bare shaft. As shown, the ends of the liners are tapered down for a length of 4 1-2 inches. This is for two purposes. One is to gradually decrease the strength of the liner, which acts as a stiffener, and the other for the following protective purpose.

The bare part of the shaft, between the two liners, is painted with antifouling composition, then a thick coat of white lead and tallow is put on, then marlin is wrapped around the shaft, the taper parts of the liners permitting the gradually lessening of the marlin wrapping, allowing a tight job to be made. The mixture of white lead and tallow squeezes between the turns of marlin, and if the whole job is done in a workmanlike manner, it will last for ten or twelve months, until the next inspection, when the whole operation is repeated. Very often the bare part of the shaft is protected by another liner, or in other words instead of using one length of the liner to cover the whole shaft, two, three or four lengths are used.

As is readily seen, butt joints between the several lengths of liners are of no particular benefit, since the working of the shaft tends to separate the lengths and thus allow salt water to act in conjunction with the

brass liner upon the shaft, thus tending to develop corrosive action.

In Fig. 2 is shown a method of joining the ends of liners, a method used by a prominent shipbuilding company with eminent success.

As will be seen from Fig. 2 the part of the shaft where there is no bearing is simply covered by the liner, which is curved out larger than the diameter of the shaft, thus saving machine work and rendering the liner more flexible and better able to accommodate itself to the movements of the shaft.

c. Design of Taper Part of Shaft.

Seaton advocates a taper of 3-4 inch to the foot, but when such a taper is used it is found necessary to heat the boss in removing the propeller from the shaft. This heating the propeller boss to remove it from the shaft is very often apt to loosen the liner from the shaft, allowing dirt to get underneath and thus preparing a way for the water to commence its corrosive action. A taper of 1 inch to the foot is perhaps better, but when the taper is still increased, then the small end of the taper

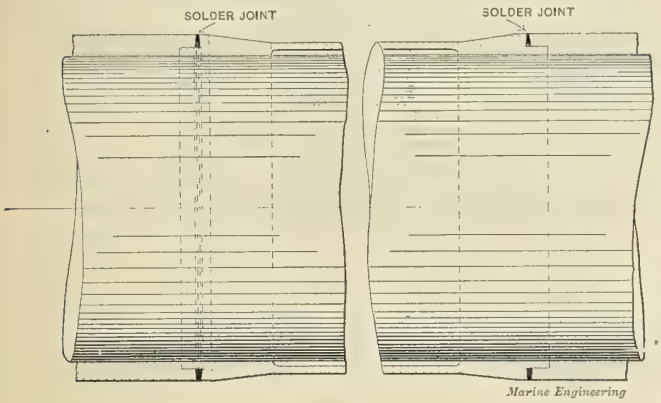


FIG. 2.

part becomes so small as to leave little room for the key.

d. Key.

Seaton gives the following formulæ for the breadth and depth of key.

Breadth of key = .22 × largest diam. of shaft + .25 inch.

Depth of key = .55 × breadth.

The breadth given by this rule is entirely too large, and I have modified it in several cases, where new shafts were fitted and using the old hubs, by filling up the old key-way in the hub and cutting a new, smaller one, to the formula.

Breadth of key = .2 × diameter of shaft.

Depth of key = .55 × breadth.

The reason which led me to change the formula for the breadth was furnished by the action of a tail shaft key-way which came under my observation. The breadth of the key-way was made according to Seaton's formula; after running some time the shaft was drawn in for inspection and it was found that the key had split the taper part of the shaft along the key-way where it was weakest, the metal not being of sufficient strength to withstand the thrust of the key.

Then the taper part was turned up on the shaft, the distance lost in length being made up by the distance pieces between the couplings of the tunnel shaft, and a new key was cut to the same dimensions as before.

Again the shaft was split, and then when the new shaft was made the breadth of the key-way was reduced to that given by the above formula and has given perfect satisfaction since.

e. Hub.

Fig. 3 shows a method of preventing the water from coming into contact with the taper part of the shaft. As is readily seen, the hub is bored larger than the shaft

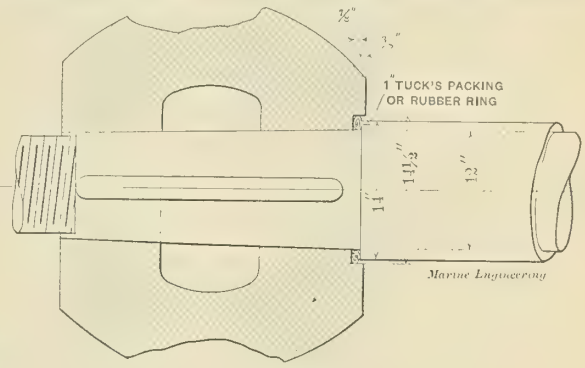


FIG. 3.

liner, and when the hub is in place the rubber ring or a turn of 1 inch Tuck's packing is squeezed up in such a way as to force it tight all over, thus preventing all entrance of water. As is also shown, the end of the key does not come within 1 1-2 inches of the liner, so that the key does not interfere with the packing.

When the propeller boss is fitted in the shop (which ought to be done very carefully, by the use of red lead paint), care should be taken to make the hub bear on the forward part, since the after part is steadied and taken care of by the nut.

f. Nut and Nut Fastening.

The methods of fastening the nuts are many, and every designer and engineer has a method which is perhaps as good as another, and as far as the nut itself is concerned some engineers use slotted nuts and spanners, while others make the nut with two lugs and drive it on with a ram.

A New Marine Publication.—The *Maritime News and Review* is the name of a new weekly publication devoted to shipping interests on the Atlantic and Gulf coasts. This sheet is published every Tuesday evening by the News and Review Company, Incorporated, Merchants' Bank Building, Baltimore, Md. The paper is devoted to items of news in the marine field, and the first two issues which have appeared are indeed most creditable and give promise of a strong paper. Items of interest along the coast, in the shipyard, and among the yachtsmen are taken up. Features which are of special note are the bar and channel tables of various ports, pilot tariff, towage tariff, and port charges of ports along the Atlantic seaboard. Many interesting topics of the present day are dealt with. The subscription price is $3 a year, 10 cents for a single copy.

A TRAINING SCHOOL FOR MARINE ENGINEERS.

BY MATT. W. COLQUHOUN.

One of the most useful of the many institutions fostered by the Commonwealth of Massachusetts is the Nautical Training School. Its object is the training of young men in seamanship and marine engineering, and its home is the *Enterprise,* one of our old naval vessels, bark rigged, built of wood at the Kittery Navy Yard in 1875, of 1,375 tons displacement, speed 11 knots, with engines of the horizontal, back-acting, compound, condensing type, and developing about 790 I. H. P. The officers, who act as the instructors, are detailed for this special work by the Navy Department.

The young cadets having graduated from a two years' course in this school have a great advantage over others, for they have had training, both mentally and physically, which makes them amenable to discipline in all its phases, and frequently preference is given over those who have had many years' experience of the ordinary character. Then, again, there is a law compelling the subsidized steamer lines to carry one cadet for every 1,000 tons burden, and recently a bill was read before

THE TRAINING SCHOOL SHIP ENTERPRISE.

THE CADETS OF THE ENTERPRISE.

the Senate asking that the cadet standing first in his class be rewarded by an appointment by the President to take examination for entrance to our Naval Academy at Annapolis, the cadet standing second to be his alternate.

The qualifications necessary for a candidate are that he must have either a parent or guardian residing in the State of Massachusetts, to sign necessary papers; that he should be between the ages of sixteen and twenty, of normal size, sound constitution, and free from all physical defects. He must also pass a physical examination before the ship's surgeon, must be of good character, have an inclination for a seafaring life, and enter the school of his own free will.

SUNDAY AT SEA—AIRING LOCKERS.

The young man, having shown the necessary qualifications, is now a cadet and may elect the class in which he wishes to receive instruction, Seamanship or Engineering. During the winter term, when the old boat is snugly tied up at her berth in Boston, the cadet receives instruction in engineering, English, mathematics, hygiene, and electricity. In spring, however, he lays aside his books for the practical side, for about the first of May the ship is prepared for sea for her annual cruise in foreign waters.

After rigging ship, sails bent, and provisions stored, the *Enterprise* sails on a trial cruise which usually lasts a week and extends as far as Gloucester, Marblehead, and Massachusetts Bay, steaming about, allowing the cadets to become acquainted with their respective duties, and then at last the long-looked-for day of sailing for a foreign shore is here.

Once outside Boston Light, should there be a fair wind, engines are stopped and sails set, propeller uncoupled and left to drag; and it is here that the cadet electing to receive instruction in the engineering department has the advantage, as he also turns to and learns seamanship with his fellow seaman cadets, both standing deck watch and furling sail, but ever ready, when word is passed, to take watch below and take his first lesson in coal heaving and cleaning bilge, but soon advancing to the positions of fireman, water tender, oiler, platform, and dynamo room.

The cadets are divided into three watches, the cadets in a watch having their respective stations, together with a few older men who act as instructors.

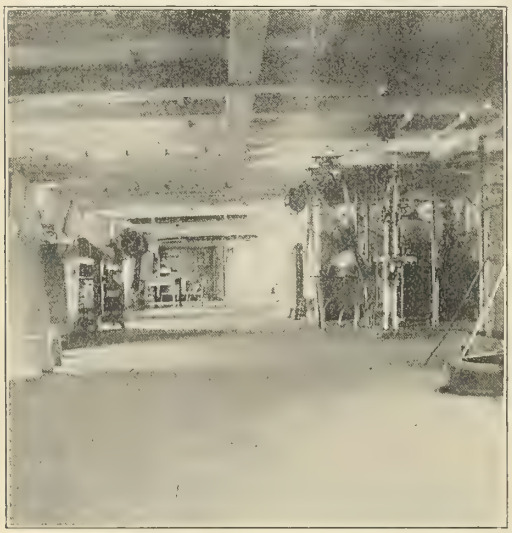
During the watches the cadets are instructed in the following: Practical work in running engines and pumps; taking and working out indicator cards and calculating slip; adjustment of parts of machinery, examination, care, and repairs of machinery; packing and making joints; pipe fitting; care of boilers when not under steam; preparing boilers for use; firing and maintaining steam; tending water; taking saturation of water in the boilers; methods of reducing saturation and preventing deposits of scale; circulation of water in boilers; use of distillers and evaporators and auxiliary engines; mechanics; electricity; magnetism; light; heat; working in wood and iron; mechanical drawing; compound, triple, and quadruple expansion engines; wiring for electric light; running dynamo and care of the electric plant; positions and use of valves, lead, and use of all pipes. But then the life of the cadet is not all work, for when in port each cadet is allowed shore

ON THE LOWER TOPSAIL YARD.

leave, one watch ashore each day, and special permission may be granted for a longer leave of absence when in such ports as Queenstown, Leith, Southampton, London, Antwerp, Havre, Stockholm, Copenhagen, Lisbon, Gibraltar, Tangiers, and Madeira, thus affording the cadets a grand opportunity of seeing the world.

The last foreign port of call is usually Funchal, Madeira; and Madeira may appropriately be called the "Garden of the World," for there abound lofty mountains, radiant with varied vegetable growth, and cut by deep gorges and ravines where rushing torrents once probably had their beds. On these mountains, as far as the eye can reach, are vineyards from whose grapes the finest wine is made; lemon and palm groves, fig trees and tropical gardens cover the mountain sides. Every-

where the air is laden with the perfume of flowers. It is customary for natives and visitors to this island to ascend these mountains on horse or mule back, and descend on sledges which are made for the purpose. The boys ascended the mountains for 2,000 feet, from whence a magnificent view could be obtained of the surrounding



GUN DECK AND MACHINE SHOP.

peaks, town, and ocean. The day of leaving for home is one generally never to be forgotten; the homeward-bound pennant is broken out, the bugle sounds, all hands on the catfalls, and at the word "Hoist away"

VIEW ON THE SPAR DECK.

the old anchor comes up as never before, and with Funchal fading away in the distance, course is laid southwest for the trades. Then for forty days we sail with nothing but the monotony of drill, broken perhaps by an occasional hurricane, for when abreast the Bermudas wind began to rise; there were frequent squalls, short and violent, with much rain, and every indication of a hard storm. The wind rapidly became stronger, and soon the storm, or West Indian cyclone, was upon us in all its violence. We ran before the gale under goose-wing topsails, fore storm staysails, wing topsails, and storm spanker; the ship was then hove to, oil poured upon the waves to quiet them, but before the gale abated much damage was done. Several boats were broken, machinery disordered, and considerable loss by sails being carried away. The ship rolled badly, the sea ran very high, and at times it seemed that the towering columns of water would crush the ship, but she rode the waves beautifully and in safety. All such experience, however, only tends toward making a cadet an efficient seaman or engineer.

CADET ENGINEERS ASHORE IN LONDON.

Boston Light is always a welcome sight to the boys three months away from home and forty-five days out from Funchal. Then, with the ship once more in winter quarters, exercises are held and diplomas are given those completing their two years, and to the rest a long-looked-for two weeks' vacation, after which they return once more for a winter term of study. Thus the boys in the State of Massachusetts have an opportunity for the study of both theoretical and practical engineering, and, once through such a training, are well qualified to pass examinations for the Revenue Service, Annapolis, or to be a cadet on a subsidized steamer.

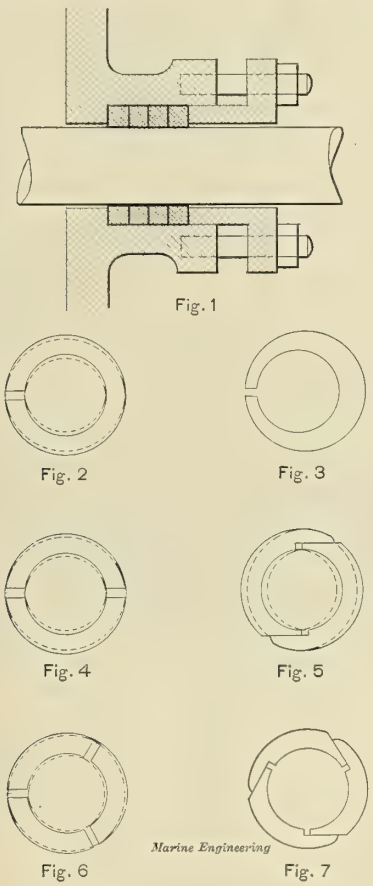
Commander Edward D. Taussig, U.S.N., is to be the new commander of the training ship *Enterprise*.

Wages of Chinese Sailors.—The United States Commissioner of Navigation, Chamberlain, has stated that, in comparing the wages paid the Chinese sailors on board four American vessels plying on the Pacific with the wages paid sailors on the *Kaiser Wilhelm der Grosse*, he finds that the average wages received by the Chinese is $21.28 per month, while on the *Kaiser Wilhelm der Grosse* it is $15.43.

OBSERVATIONS ON METALLIC PACKING.

BY C. G. ROBBINS.

Prof. R. H. Thurston showed, by a number of experiments made some years ago, that the frictional resistance of various steam engines tested amounted to 10 per cent. and upward of the rated horse power. Further experiments on the distribution of the friction showed that the greatest loss, amounting to one-third or one-half of the total friction, occurred in the main bearings; while the next important loss was the friction of the piston and piston rod, amounting, in the smallest instance, to about 21 per cent. of the total



RINGS FOR METALLIC PACKING.

friction. Of this amount about one-third, or six and one-half per cent., of the total was chargeable to the friction of the piston and rings against the cylinder walls, leaving about 14 per cent. of the total friction chargeable to the stuffing box of the piston rod.

The engines tested were of small size, and the stuffing boxes were of the ordinary type, packed with fibrous packing compressed by a gland. It is noticeable here that the packing of the piston, although of large diameter and subject to full boiler pressure, consumed only about one-half as much power as the stuffing box of the rod, although the latter is of much smaller diameter and is subject to no greater pressure. This excessive stuffing-box friction is undoubtedly due to the use of fibrous packing, which must be compressed tightly against the rod to prevent leakage.

Since the friction of the metallic packing rings of the piston, which were effective in preventing leakage, was only about one-half that of the stuffing box, it appears that the use of some form of metallic rod packing in the latter would reduce its friction in at least the same proportion, causing a gain in this case of about three-quarters of one per cent. of the rated horse power. If this distribution of the internal friction holds good in the larger sizes of engines, the question of the power required to overcome such friction is clearly a matter of some considerable importance.

Take the case of a 1,000-H. P. engine with the high mechanical efficiency of 92 per cent.; the friction load is then 80 horse power, 14 per cent. of which, chargeable to a fibrous-packed stuffing box, is practically 11 horse power. If only one-half of this may be saved by the use of metallic packing, a clear gain of over 5 horse power is assured. This will produce large returns on any reasonable investment in metallic packing, to say nothing of the longer life and less cost of maintenance.

This leads to a comparative study of the theories of fibrous and metallic packings and the determination of the reasons for the increased efficiency of the latter. The ordinary stuffing box for fibrous packings consists of a chamber on the cylinder head surrounding the rod and provided with a gland, usually arranged to be drawn into the chamber by bolts, as in Fig. 1. The box is partially filled with rings of soft or fibrous packing cut in proper lengths to neatly encircle the rod. This packing is elastic, so that when it is compressed in one direction it expands in the other; and the screwing down of the gland thus forces the rings outward against the inside of the box and inward against the surface of the rod. When properly adjusted, the steam pressure is admitted to the inside of the cylinder, the rod is moved slowly to and fro, and the gland is screwed down until steam ceases to blow through, thus adjusting the packing under the conditions of pressure, temperature, and movement under which it has to work. Even under these conditions it is evident that the packing must be set very tightly against the rod to prevent leakage, and that considerable force must be exerted to pull the rod through the packing. But the most serious defect of this style of packing lies in the fact that the operator does not always set up the packing under working conditions; nor does he cease screwing down the gland when the leak is stopped, but sets up the packing as tightly as possible when cold, and thus grips the rod with much unnecessary force.

Contrary to fibrous packings, the rings of metallic packing are not elastic, and compression in a direction parallel to the rod will not cause them to bulge or expand toward the rod. Some other means must be found to allow them to adjust themselves to the surface of the rod. This is almost invariably done by cutting the ring into segments and leaving a slight clearance between the ends. The evenness with which the rings press against all parts of the circumference of the rod will depend in a measure upon the number of segments and the lines upon which they are divided.

In Fig. 2 is shown a plain concentric ring cut in one place only. Pressing the ends of the cut together would evidently cause the ring to assume something of the

shape shown by dotted lines and to grasp the surface of the rod unevenly. Possibly a ring of the shape of Fig. 3 could be made to contract more in conformity with a true circle. But even if this could be done, it is necessary to cut the rings in at least two parts to avoid disconnecting the rod for renewals.

The next evident step is the division of the ring into halves, as in Fig. 4. Assuming the rings to be inflexible, the pressure of the rings against the rod will bring them into the position shown in dotted lines; the most wear will take place at the top and bottom, and the rings will adjust themselves, by wear, very closely to the contour of the rod. Another method, sometimes used, of dividing the ring into halves is shown by Fig. 5; this answers the same purpose as Fig. 4. The next step is the division of the ring into three parts by cuts radial to the rod. Fig. 6 shows this arrangement, and the dotted lines show the movement inward and the nature of the wear necessary to allow them to accurately fit the surface of the rod. Fig. 7 shows another three-segment ring divided in a different manner.

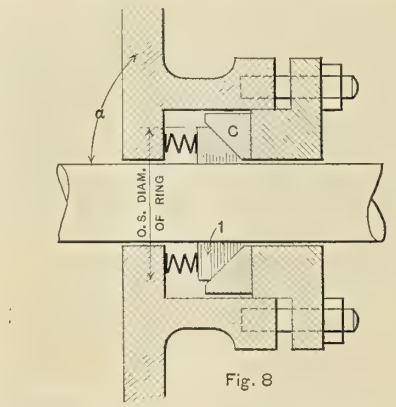
All these arrangements, except the first, are in common use among the manufacturers of metallic packings. Since in every case the rings are cut in at least two places, through either of which steam might blow while the remainder of the rod circumference was tight, it is evident that the rings must be in pairs and arranged to "break joints," the second ring packing or covering the joint in the first. This is always done, and usually their relative positions are fixed by dowel pins fitting into holes in the adjacent rings.

We have seen how the rings are arranged to enable them to grasp the rod with some force and to move inwardly against its surface as wear takes place. Metallic packings are always arranged to automatically adjust themselves, and it will be interesting to see how this is done. Broadly speaking, there are two general methods of holding the rings to the rod. The first is by means of sliding surfaces inclined at an angle to the axis of the rod and down which the rings slip. This method may or may not involve the use of springs acting parallel to the rod.

The second method is by the direct action of an encircling or sphincter spring, usually of coil shape, or by other exterior springs pushing toward the rod centre. A few packings really belonging to this second class use the encircling spring merely to hold the rings in position, and depend upon the steam pressure, which is allowed to get behind the rings, to hold them to the rod.

Fig. 8 shows diagrammatically a packing of the first class, using inclined sliding surfaces and springs to adjust the packing to the rod. The packing rings are forced into the cone as wear takes place, contracting their outer diameters and gradually closing up on the rod, as shown by dotted lines in the previous illustrations. It is evident that the steam pressure is free to act on the back of ring 1, and that the force pushing the rings into the cone is made up of the constant pressure exerted by the springs and the mean effective pressure of the steam in the cylinder. Assuming that there is no friction between the cone and the outer circumference of the rings, it is evident that by the simple force polygon of Fig. 9 we can find the pressure with which the rings grasp the rod. All that is necessary is to draw the line AB proportional by scale to the force pushing the rings into the cone; the line AC parallel to the inside surface of the cone or sliding surface; and the line BC at right angles to AB; then BC measured by the scale to which AB is drawn will give the force grasping the rod. If now we know the coefficient of friction between the rod and the packing, we can calculate the pull necessary to slide the rod through the packing. This pull multiplied by the piston speed in feet per minute will give the foot pounds of energy required to overcome the friction of the packing; and this divided by 33,000 gives the horse power lost in the box.

Take the case of the 1,000 horse power cross-compound engine previously mentioned, in which the initial steam pressure will be taken at 160 pounds, the piston speed at 750 feet per minute, each piston rod at 4 inches diameter, and the mechanical efficiency at 92 per cent. Then the friction of the fibrous-packed stuffing boxes amounts to 11 horse power, on the basis of Thurston's experiments. The probable maximum friction of metal-



INCLINED SURFACE METALLIC PACKING.

lic-packed rod boxes may be found as follows: The outside diameter of packing ring 1, Fig. 8, will not be over 6 inches, and the area upon which the steam pressure acts will be the difference between the areas of a 6-inch and a 4-inch circle, or 15.6 square inches. The mean effective pressure in the high-pressure cylinder is about 60 pounds, and if we assume the springs to exert a constant force equal to 40 per cent. of the initial pressure, or 64 pounds per square inch, the total pressure acting on the back of ring 1 is $60 + 64 = 124$ pounds per square inch. Then the total pressure AB, Fig. 9, tending to force the rings into the cone, is $15.6 \times 124 = 1{,}934$ pounds. If the angle of the cone is 45 degrees, as is not uncommon, the force polygon of Fig. 9 shows that the pressure against the rod is also 1,934 pounds. If we assume a coefficient of friction of 3 per cent., the force required to pull the rod through the packing is

1,934 × .03 = 58 pounds. At 750 feet piston speed, the power exerted is 58 × 750 = 43,500 foot pounds per minute, amounting to 43,500 ÷ 33,000 = 1.32 horse power. Taking the low-pressure cylinder at the same amount, we have 2.64 horse power for the friction of the piston rods, or about one-fourth that of the fibrous-packed boxes. When the rings are held to the rod by encircling springs, as in Fig. 10, or by the steam pressure acting on the outer circumference, it is more difficult to find the pressure against the rod. The tension of the springs and the area of rings exposed to the steam pressure must be known. The pressure is probably about the same as in Fig. 1.

In any case it seems plain that the friction of metallic packings will be materially less than that of fibrous ones. The rings being of metal can be finished, and will wear, to a practically perfect fit on the rod, and so require only a comparatively light pressure to make a steam-tight joint, while the highly polished surfaces quickly acquired will reduce the coefficient of friction to a minimum. On the other hand, the fibrous rings cannot, on account of the nature of the material, be fitted so accurately to the rod nor acquire so perfect a polish; nor do they, as a rule, automatically adjust themselves to wear, but must be compressed by the gland, so that their natural elasticity, or expansion, compensates for wear. All this tends toward an excessive pressure against the rod, with a corresponding increase in friction.

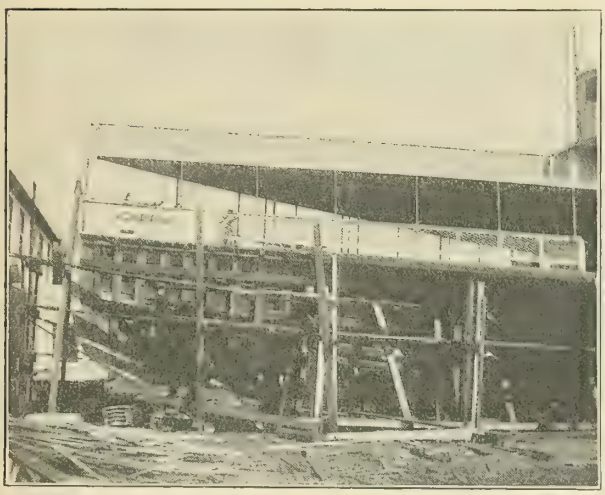
Harvard Engineering Journal.—Beginning with April, the first number of a journal devoted to the interests of engineering and architecture, and called the *Harvard Engineering Journal,* was published at Harvard University. It is a well-printed journal of 80 pages, and in the first issue appear articles upon engineering at Harvard and a description of the Steam Loop and Holley Gravity Return system for boiler plants. The subscription rates are $1 per year in advance and single copies 35 cents. All communications should be addressed to the *Harvard Engineering Journal,* Pierce Hall, Cambridge, Mass.

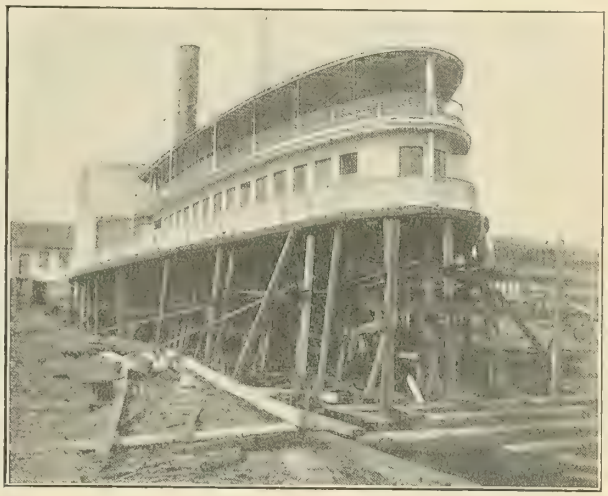
Building a New Hull for an Old Boat.

Something quite out of the ordinary line of vessel building and repairing was to be seen at the yard of the Robert Palmer and Son Company, Noank, Conn., where hauled out on one of the railways was a paddle-wheel craft about 200 feet long.

The framework of this vessel was sadly in need of repair—that is, if the fragments of the old timbers are anything to judge from—but the upper works were in good condition, and for this reason it was suggested by the owners that it would be advisable to have a new hull built, leaving at the same time the upper works intact.

Uprights were therefore placed so as to take the strain of the superstructure from the hull, which was then cut into and removed in sections, care being taken that the model of the old hull should be reproduced in the new framework; for though the boat is an old one, the shape of the hull was considered good. The engines and boilers are still in her and were not removed, but simply raised sufficiently to admit of putting underneath them the keel, frames, etc. A keel was laid and frames erected, just as though a new vessel were being built, but great care had to be taken to see that everything coincided, as there were obstacles to be overcome that would not occur in a vessel built in the usual manner.





BOW AND STERN VIEWS OF THE NEW HULL BUILT UNDER AN OLD BOAT.

As can be seen from the photographs, everything from the main deck upwards is standing, even to the smokestack and short masts, and the uprights supporting the upper works are clearly discerned. The engine bed has been replaced by a new one, and in fact all the interior work of this craft will be new. The tanks which were situated alongside the engine were removed and are now aft of the same, but will eventually be placed in their original position.

All of the deck beams are in good condition, but at intervals there are placed beams of yellow pine 10 by 12 inches, which will add considerably to the strength.

When finished the boat will be much stronger than originally and will be a fair sample of what can be done in these days of advancement.

AN EXPERIMENTAL ELECTRIC LAUNCH.—I.*

BY PROF. OSWALD FLAMM.

The many attempts which have been made to utilize electricity for the propulsion of boats have not on the whole met with the success which had been anticipated. While, indeed, high propulsive efficiencies were realized, yet the practicable speed, the radius of action and other peculiarities were far from satisfactory. The chief difficulty in connection with such boats lies in the small weight efficiency of the propulsive equipment with its accumulators and motor, and in the fact that in this respect the naphtha and various forms of petroleum motors, as well as the steam engine, all show a decided superiority. It should, however, be admitted that the electrical engineer has thus far given but slight attention to the conditions and requirements of a motive equipment for marine propulsion, and that for the most part he has been concerned with types of construction suited for stationary service, but which by reason of their large dimensions and weight are not suited for the propulsion of boats.

A like relation exists to-day between the steam engine for stationary service and the best types of marine engine, and as the designer and builder of the latter have been able to produce an engine of maximum output for minimum size and weight, so must the electrical engineer, if he wishes to provide for boat propulsion a suitable equipment, devise means for vastly increasing the output for a given weight of electrical equipment, in comparison with conditions as they now are. It may be in fact pointed out that in these particulars notable improvements and advances are not only possible but probable. Should the problem of electric propulsion for boats be again undertaken, an effort should be made to enlist the warmest coöperation between the boat builder and the electrical engineer, so that while as regards the boat every advantage may be taken of modern advances the better to adapt the boat to the purpose in view, so also the electrical engineer may, more perfectly than hitherto, adapt the means at his disposal to the same ultimate purpose.

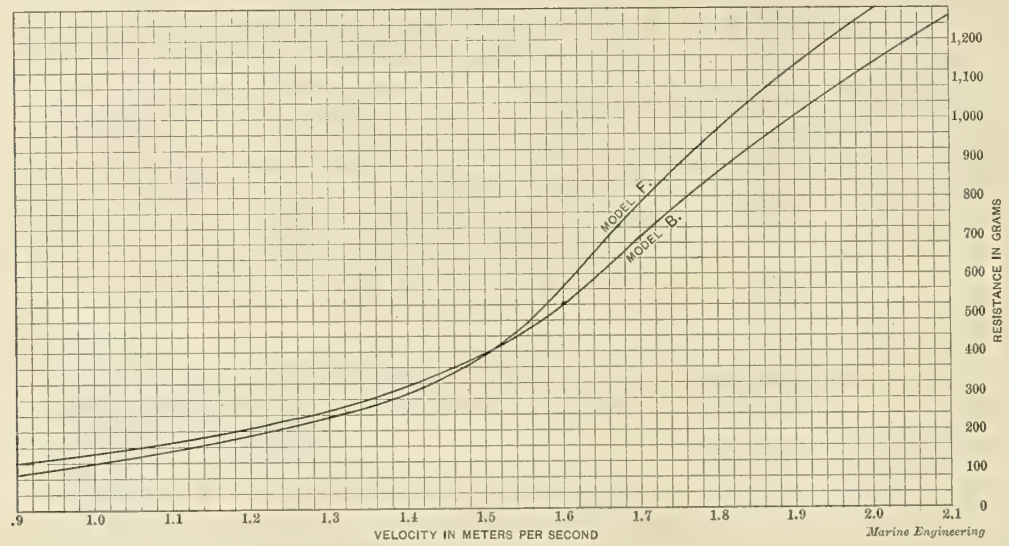


FIG. 1.—COMPARATIVE RESISTANCES OF TWO MODELS.

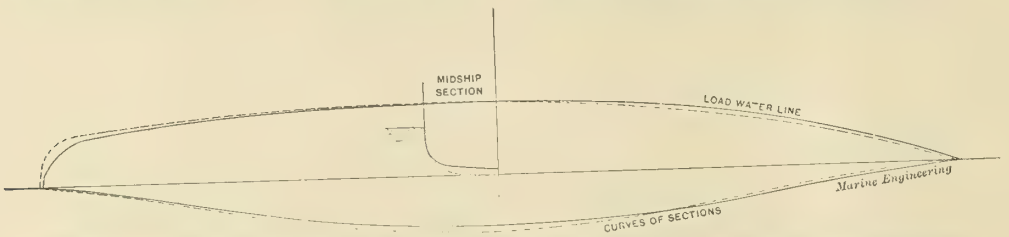


FIG. 2.—LOAD WATER LINES AND CURVES OF SECTIONS OF THE TWO MODELS; MODEL B IS IN DOTTED LINES.

When one considers the many valuable features which an electrical propulsive equipment possesses, so is one filled with the desire to realize them in marine practice in so far as conditions will possibly permit. Even aside from the fact that an electric boat furnishes unobstructed deck and cabin room for the use of those on board, the nautical qualities of such a boat provided with storage battery, may by a suitable disposition of the latter be modified in such manner as desired. Furthermore, the operation is clean and simple, and in localities where charging stations are at hand or where they may be readily reached, electric propulsion for certain purposes will doubtless increase in favor.

With these various points in view, the Watt-Accumulator Works in Zehdenick, on the Havel, built last year an experimental electric boat. The electrical equipment,

*Translated from Schiffbau, February 8, 1902.

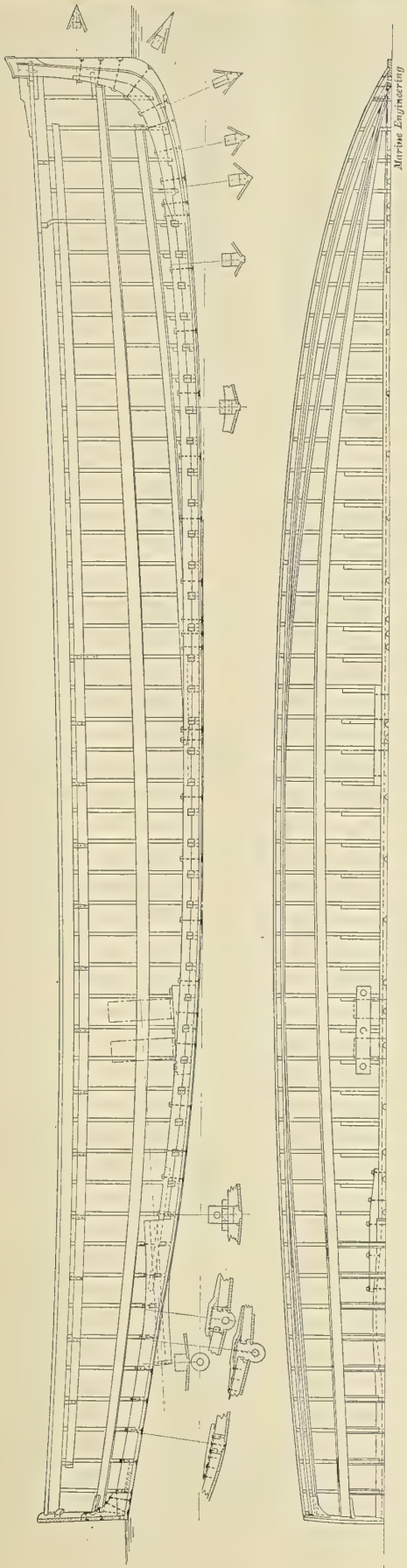


FIG. 3.—LONGITUDINAL AND DECK PLAN OF EXPERIMENTAL LAUNCH.

as well as the construction of the boat, was undertaken by the above named firm; while the technical features of the boat, as well as of the propeller, were undertaken by the writer. The boat was completed in the autumn of 1901, and has since then undergone numerous trials in Stettin, also from Swinemünde to the open water, and later, on the Tegeler See near Berlin. A report of the results of these trials will perhaps possess some interest.

For the form and dimensions of the boat two designs were prepared as follows: Design B was 52.5 ft. in length on the water line, 8.2 ft. in width outside the planking, 2.62 draft midships, with a displacement of 17.3 tons in fresh water. Design F had the same length and beam, a draft midships of 2.95 and a displacement of 18.3 in fresh water. Smooth wooden models to a

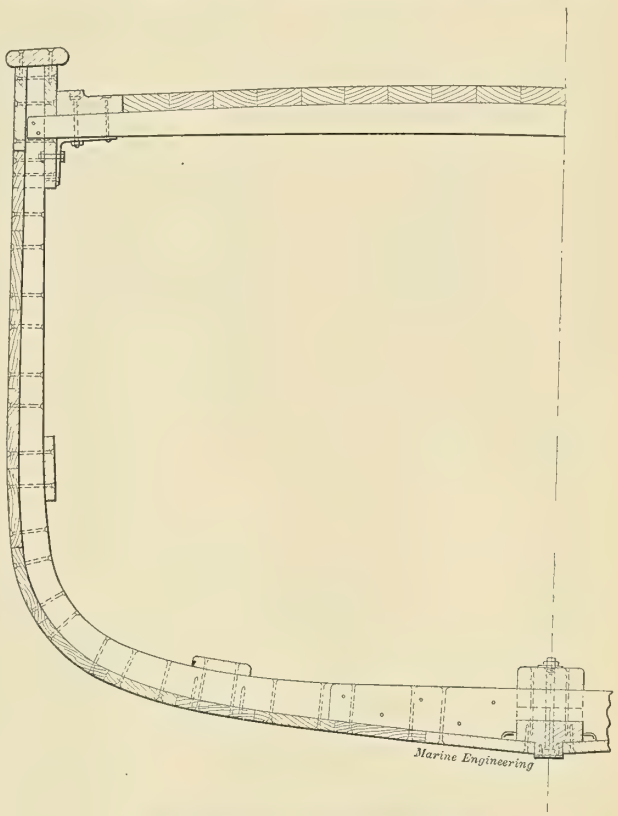


FIG. 4.—MIDSHIP SECTION OF LAUNCH.

scale of 1 : 10 were made of both designs and tested at Bremerhaven in the experimental tank of the North German Lloyd Co., with regard to their resistances at various speeds. The results of these tests are shown in the diagram of Fig. 1. The construction water line, curve of section and form of midship section for each design are found in Fig. 2. A number of wave photographs for each boat at varying speeds were made at the time of trial. One of the most interesting results of these tests is found in the relative influence of skin resistance and form resistance, which is clearly shown by the curves in the diagram of Fig. 1. With model B having a finer form forward, but greater wetted surface, although with a 6 per cent. smaller displacement, at low speeds for which the form resistance was not of so great importance, the resistance was greater than that for model F with less wetted surface, greater draft and

greater displacement as stated. As the speeds were increased above 295 feet per mt., corresponding to 9 1-2 knots for the boat, the superiority of model B over model F, due to its better form for high speed, became plainly apparent. It yet remains to determine whether it is possible under existing conditions to supply sufficient electric power to drive the boat at a speed above 9 1-2 knots, and thus realize the superiority of the form of model B. On the other hand, however, the question of the radius of action of the boat at moderate speeds was of importance, and for these conditions the form of model F was sensibly better than that of model B. In consequence a new design was prepared intended to unite the superiority of model F for the low speeds with that of model B for higher speeds. The actual boat

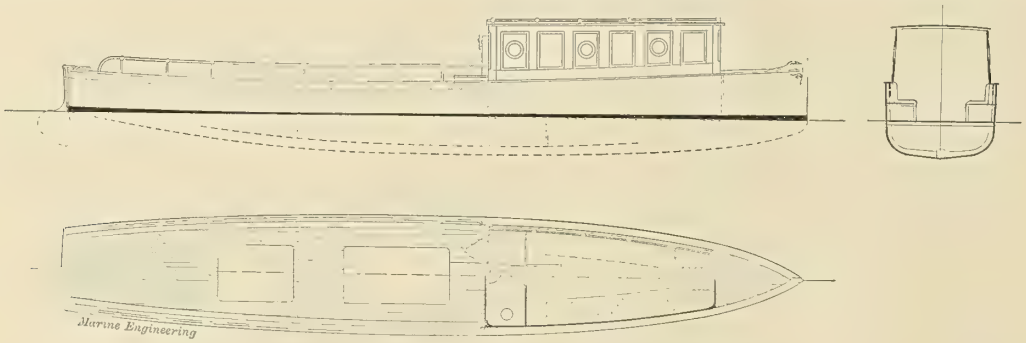


FIG. 5.—GENERAL ARRANGEMENT PLANS OF EXPERIMENTAL LAUNCH.

was built in accordance with this model, and of the following dimensions and particulars.

Length on the water line	52.8 ft.
Beam on the water line	8.2 ft.
Draft amidships	2.62 ft.
Depth	5.09 ft.
Displacement	17.5 tons.

The metacentric height as determined by the usual inclining experiment was found to be about 1.31 ft.

The boat was built of wood, the frame of the best oak, the keel and sheer strake of oak, the remaining planking of yellow pine. A smooth continuous deck of yellow pine was fitted, and the water ways were made of oak. The usual stringers and tie pieces were also fitted as shown in the section. The general plan of the boat is shown in Fig. 3, the structural section in Fig. 4, and the deck plan and profile in Fig. 5.

(To be continued.)

U. S. Coaling Station, Frenchman's Bay, Maine.

The site selected is ideal for its purposes. The Government owns about sixty acres, having a water front of a third of a mile. Eastern Bay affords a safe anchorage for a large fleet, and the islands near the entrance make it almost impregnable to attack when fortifications are erected, as they will be when the entire scheme is carried out. In time of war the station would be the principal base for practically the entire New England coast as far west as Boston.

The main building at the station will be a granite and steel coal house, with a storage capacity of 10,000 tons. There will be a steel coaling pier 400 feet long and 48 feet wide, the front face of which is in thirty feet of water at extreme low tide.

As there is a heavy rise and fall of the tide in the bay, the problem of constructing a pier for the use of large ships was a difficult one. This has been met by driving steel pipe piling clear to the rock and filled with concrete, braced and capped and decked over, which makes the steel pier superior to any other now built.

On the pier are two powerful steel traveling towers that pick up the coal from colliers and dump it into cars that run on tracks into the monitor of the coal house, until at a proper place they discharge their loads into the house proper.

When a vessel is to be coaled cars are run on the tracks underneath the storage floor of the coal house, and by means of valves, the floor above is opened at numerous points, and the coal comes running down into the cars, which then continue their journey through the tunnels, and the coal is discharged into the waiting man-of-war.

The whole process of receiving coal from colliers into the house and delivering it from the house to vessels is practically mechanical, and requires little hand labor. There is an endless chain of cars running in each direction, and worked by the powerful machinery. From 100 to 150 tons can be loaded or unloaded every hour.

The danger most feared in all large coal piles is spontaneous combustion, and to prevent this unusual precautions have been taken. The coal house is divided into sections by massive cross walls, so that should fire break out in one section it can be confined to its place of origin and prevented from spreading. The house is completely equipped with apparatus that will instantly record any rise of temperature, which will give timely warning of fire.

Besides being a coaling station a water system will be erected by which ships can be provided with fresh water for steaming purposes, and the grounds of the depot will be prepared for the use of crews for drilling and small arms target practice.

When completed the new depot will cost $250,000. The contractors expect to turn it over to the Government during the coming season.

Japanese Ship Combine.—For preventing the Atlantic shipping trust from obtaining control of the traffic interests of the Asiatic coast, eleven Japanese steamship companies have formed a steamship combine, with headquarters at Osaka, Japan.

CARE AND MANAGEMENT OF THE MARINE GASOLINE ENGINE.—II.

BY E. W. ROBERTS.

The methods of supplying fuel to a gasoline engine may be divided into three classes. The first or older method is known as the carbureter system, and consists of enriching the ingoing air or a portion of it by evaporation of the gasoline. This is accomplished by passing the air either through or over a large body of the liquid. This divides carbureting systems into two methods: the first, in which air is passed through the fuel, giving the filtering carbureter, the other method being that of the surface carbureter.

CARBURETERS.

An example of the filtering carbureter is shown in Fig. 7, the principle only being illustrated. Air is drawn

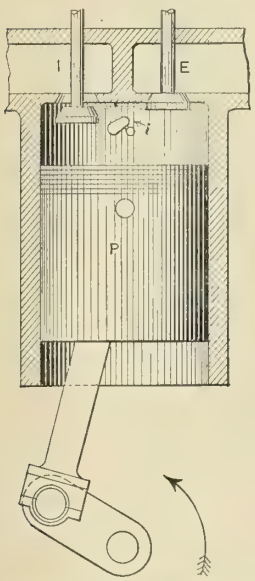


FIG. 1.—SUCTION.

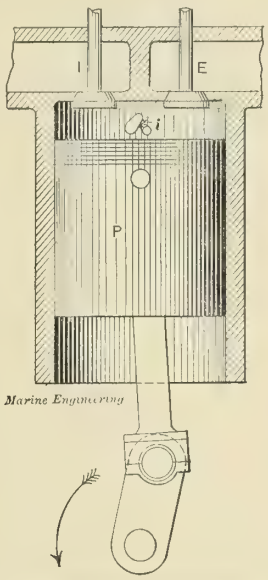


FIG. 2.—ENDING COMPRESSION AND IGNITING.

KEY FOR TWO AND FOUR-CYCLE TYPES, FIGS. 1, 6:

I = Inlet.	D = Deflecting Plate.
E = Exhaust.	C = Check Valve.
P = Piston.	J = Jacket.
K = Crank Case.	i = Igniter.

to the engine through the pipe a, the vacuum formed in the tank causing air to enter through the pipe b and to bubble up through the body of the gasoline, evaporating a portion of the fuel, which makes a rich mixture of air and gasoline vapor. As the air carries with it particles of gasoline held in suspension and still in the liquid state, it is necessary to use a sheet of wire gauze, g, to act as a separator, so that only gasoline vapor and air pass out through the pipe a to the engine. Several layers of gauze, g^1, are usually inserted in a in order to prevent flame from striking back into the carbureter in case of a backfire through the inlet valve.

A surface carbureter is illustrated in principle in Fig. 8; air entering at b, passing over the various partitions w, and beneath the partitions p, so that the air is compelled to pass quite closely to the surface of the gasoline in the bottom of the tank, finally leaving at a on its way to the engine. The surface of the liquid is often increased by attaching wicking to the partitions w, as indicated in the figure. Quite frequently the partitions w are laid in the form of a spiral extending to the top of the tank, the air entering at the centre and passing from the carbureter at the outer end of the spiral, as indicated in Fig. 8A. In some forms, a portion of the exhaust gases are passed through a pipe in the bottom of the tank in order to accelerate the evaporation.

Carbureters are very little used at present, being supplanted by the more efficient and less dangerous vaporizer. Carbureters evaporate the lighter portions of the fuel, leaving a residue which must be thrown away. They are also affected by changes in the atmospheric conditions, as any increase in the humidity of the atmosphere would decrease the evaporating power of the air. No amount of wire gauze will prevent the flame

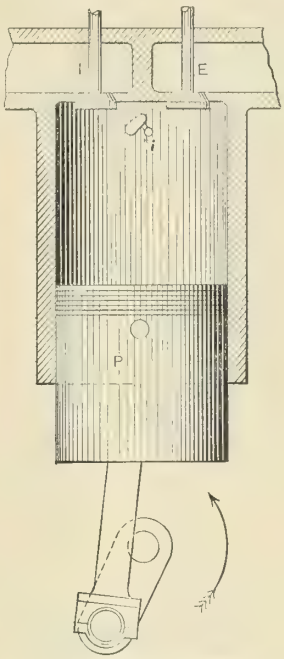


FIG. 3.—EXPANSION.

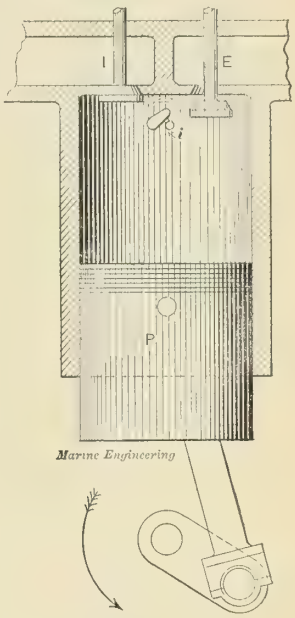


FIG. 4.—EXHAUST.

from occasionally striking back into the tank, and if the vapor and air is in the right proportion the carbureter will explode, usually with disastrous results. It is necessary to add air to the mixture from the carbureter, as it is generally too rich to give the best results, and in extremely cold weather it is quite often a difficult matter to get the carbureter started without warming it, this being a dangerous proceeding unless it is done with a moderately heated substance, such as hot water.

VAPORIZERS.

The second method of supplying fuel to the engine, and that in most general use to-day, is the vaporizer. Properly defined, the vaporizer is a device for supplying fuel to the air in just the quantity needed, and while the air is passing to the engine, the vaporizer being operated by the action of the air itself as it passes through it. In other words, the liquid gasoline flows into the air as it passes through the vaporizer, and is usually first thrown into spray and then thrown into vapor by being dashed against the walls of the inlet pipe. The reader is asked to note carefully the distinction made between the car-

bureter and the vaporizer, as there is much confusion between these terms, especially in literature relating to automobiles.

In Fig. 9 is shown what the writer believes to be the simplest form of vaporizer he has seen, and which illustrates the principle involved. The pipe *a* represents the inlet passage to the engine through which the air must pass. In it is inserted a pipe, *b*, connected with a constant-level reservoir of gasoline standing just below the top of the pipe at *b*. The suction of the air passing by *b* carries gasoline with it, the quantity of fuel being determined by the opening of valve *v*. To the average gas-engine builder this would look like a device too simple to work well, and probably would not answer for a boat; but it is a very successful device for a stationary engine, as the writer has seen the actual arrangement shown in practical operation.

Another very simple form of vaporizer is shown in Fig. 10, and consists of a check valve with a hole, *K*, in the seat of the valve *E*, through which the gasoline enters whenever the air passing through it opens the valve. The valve is held to its seat by a light spring, *M*, and the valve gives very little resistance to the passage of the air which enters at *C* and passes to the engine through the opening *X*. The flow of gasoline is controlled by the needle valve *F*, the pointer *G* serving to indicate the opening. The vaporizer is connected to the gasoline tank by a lead pipe leading from the opening *O*. In this vaporizer the gasoline being inclined to flow around the valve seat *E*, it mixes well with the ingoing air, and at the end of the compression stroke it is quite thoroughly diffused and makes a very good mixture.

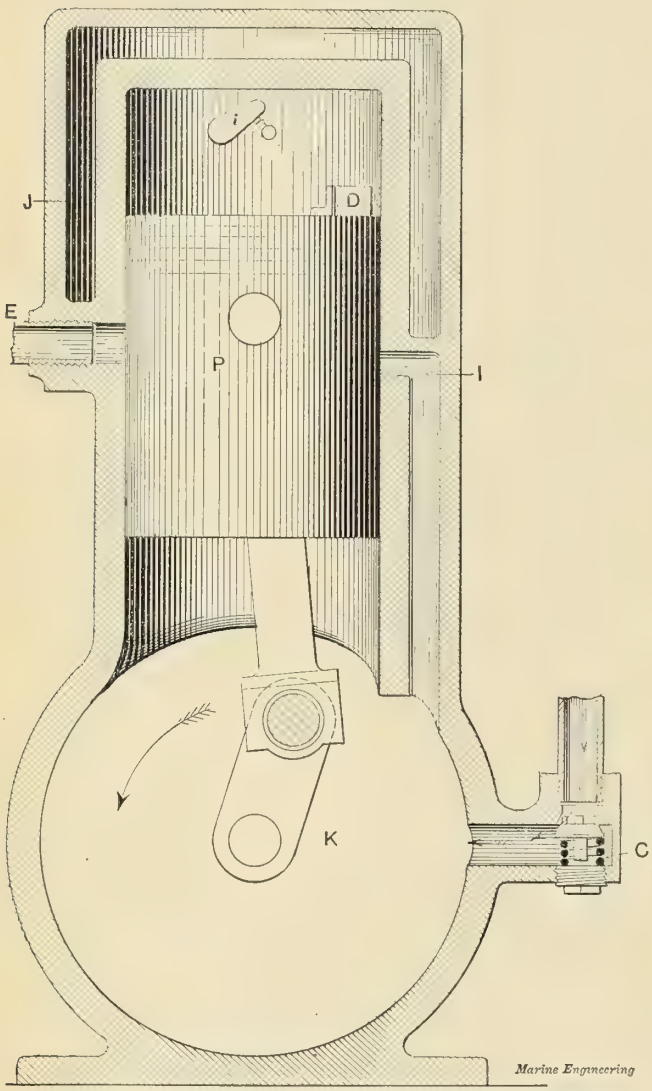


FIG. 5.—TWO-CYCLE ENGINE, NEARING END OF UPSTROKE. CHARGE COMPRESSED AND IGNITING, FRESH CHARGE ENTERING CRANK CASE.

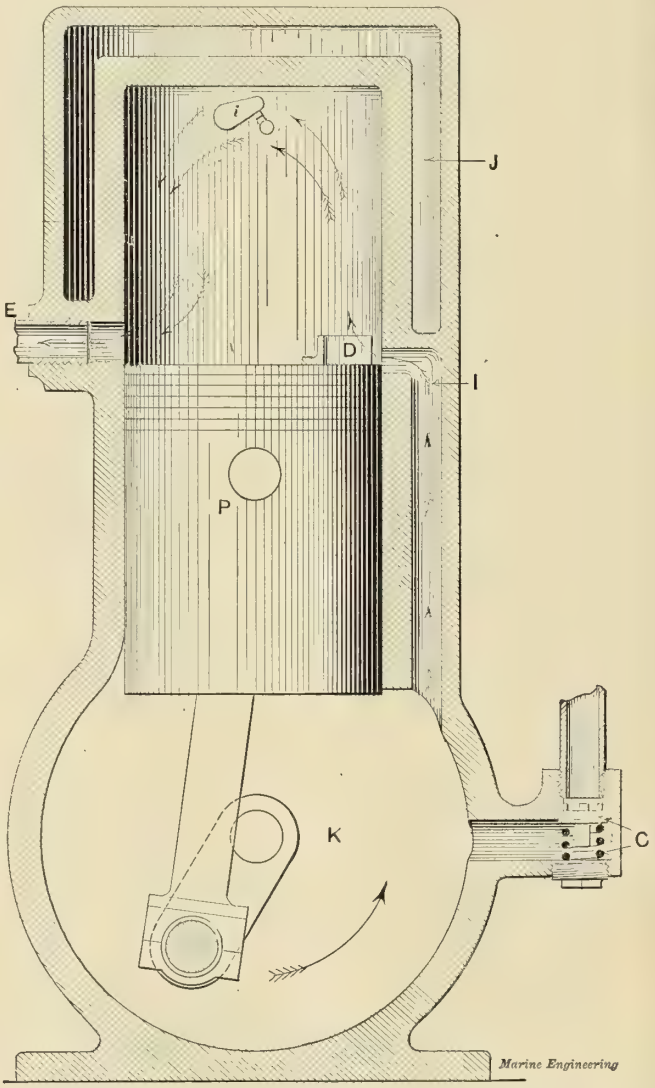


FIG. 6.—TWO-CYCLE ENGINE, NEARING END OF DOWN STROKE. EXHAUST ESCAPING. CHARGE ENTERING FROM CRANK CASE.

There are quite a number of variations of the two fundamental types shown, Fig. 9 being varied by means of a long nozzle leading into a vertical air pipe. Variations of Fig. 10 are produced by adding a point to the centre of the valve *E*, making it double-seated, and the point closing the gasoline inlet. The principle, however, is the same. In other variations of this form the valve *E* becomes a mere disc which acts as a baffle plate to open a small needle valve leading to the gasoline supply. The valve shown in Fig. 10 is sometimes used as a check

valve on a two-cycle engine, but experience has shown that it is better to have a separate valve for this purpose. These valves are also used quite successfully on four-cycle engines, although the form shown in Fig. 9, but having the nozzle in a vertical air pipe, is that most

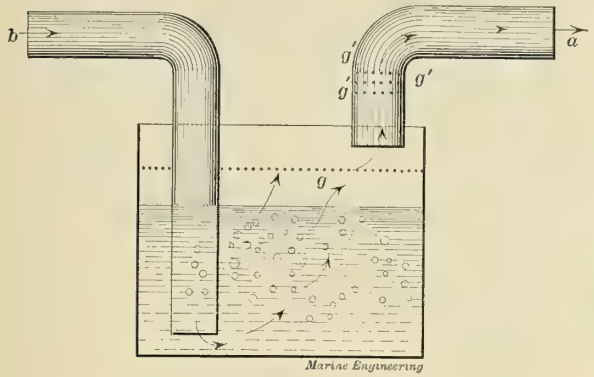


FIG. 7.

often seen in connection with the four-cycle type. The valve, Fig. 10, is quite often called a generator valve, although it really does not generate a gas. It should always be used with a short vertical pipe screwed into the

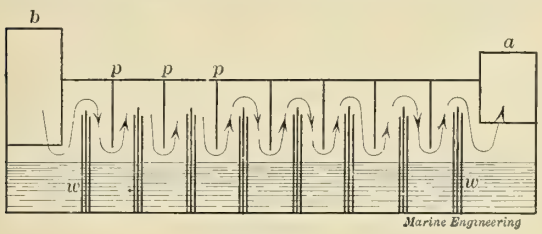


FIG. 8.

opening *C*, and also it should stand in the position shown so that the valve *E* opens in a downward direction.

It will be readily recognized by the reader that both these forms of vaporizers operate on somewhat the same

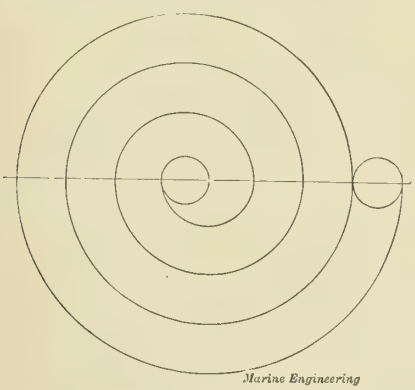


FIG. 8A.

principle as the atomizer used for perfumes. Of the two types, that of Fig. 9 is perhaps the most convenient, as the flow of gasoline always stops when the engine stops, while the generator valve will allow a small amount of gasoline to flow past the valve, and if the needle valve is not closed it will usually flood. On the other hand, a constant-level reservoir must be used with the nozzle type, else it would overflow if the stern of the boat were very much depressed.

A peculiarity of the generator valve should be noted herewith. If the engine should for any reason be speeded up, as, for instance, by increasing the lead of the igniter, the needle valve should be closed slightly, as the draft of air will be stronger. On the other hand, the valve should be given a little extra opening on starting the engine, because the draft is less than when the normal speed is attained. Sometimes starting may be assisted by depressing valve *E* with a rod or pencil, allowing a little fuel to escape into the air pipe. The opening must also be increased a little as the gasoline gets low

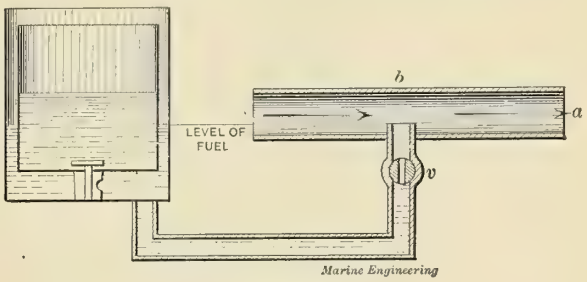


FIG. 9.

in the tank, and in small boats it will be necessary to increase the opening whenever the bow of the boat is depressed, as when the occupants go forward.

Still another form of vaporizer is shown in Fig. 11, in which a stream of gasoline is pumped continually across the air pipe *a*, as shown at *j*. Usually a part only of the air passes through this pipe, as otherwise the mixture would be too rich in fuel. There are several variations of this particular form in which the gasoline is made to flow over a piece of gauze or wicking or some other

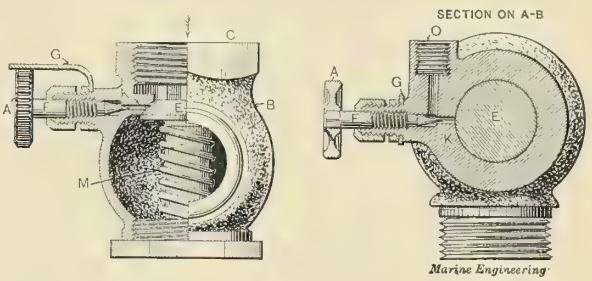


FIG. 10.

fibrous material, as cotton. This form, it will be noted, is somewhat on the order of the carbureter, but lacks its dangerous properties.

The third method of supplying gasoline to the ingoing air is known as the jet feed, and consists in the use of an extremely small pump which throws a jet of gasoline into the air pipe at the moment of induction. The pump acts independently of the suction or draft of the passing air, and is a measuring device. It is not used in marine practice, so far as the writer is aware. It is very uncertain in its action, particularly on small engines, and will not answer at all where the engine is controlled by varying the amount of the charge, as by throttling.

While on the subject of vaporizers the writer might say a few words about the throttle valve which is usually

employed for controlling the speed of a marine engine. In general it may be stated that almost any form of lever valve which can be fully opened or fully closed by a short movement of the hand will answer the purpose. It should invariably be placed between the vaporizer and the inlet valve of the engine and as close to the inlet valve as it is practicable to put it. A very convenient place for the throttle on a two-cycle engine is in the passage

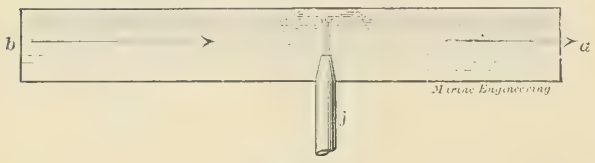


FIG. 11.

between the crank case and the cylinder. However, a good valve which controls the passage of the air into the crank case seems to answer the purpose just as well. A governor operated by the engine itself is employed by some makers, and when the speed is controlled on the hit-or-miss principle it is absolutely necessary, but for a throttle engine hand control is that most commonly employed.

(To be continued.)

REFRIGERATION ON SHIPBOARD.—III.

The Design and Operation of the Store Rooms.

BY E. N. PERCY.

Much of the inefficiency, trouble, and worry due to this class of machinery can be traced directly to the store rooms. Here is where the results of the process of refrigeration are made manifest. Here is where all of the efforts of the best machinery may go to naught if not properly made use of. If poorly designed and operated, it may be wasteful, unsanitary, unhandy, disagreeable, and positively dangerous in many ways.

The first thing about the "ice house" is its size and general arrangement. It should be large enough to carry all the provisions necessary and to allow a full circulation of air around them. In addition to this, there should be room for the brine piping, the ice tanks, and a gangway on all sides between the provisions and the wall. A very nice arrangement is to have one room for meats, another for vegetables and fruit, and a smaller anteroom for temporary storage of victuals, implements, drawn ice, and the ice-making apparatus. The piping should be as high as possible, but must be accessible for cleaning and repairing. Care should also be taken to see that it is not placed where it can drip brine or frost on the provisions. These requirements almost confine it to the sides of the rooms near the top; and here is where we usually find it in carefully designed plants for marine work. The best size and kind of piping for the brine is that which will expose the most cooling surface with a minimum of water. It must be thin to be a good conductor, yet able to withstand the corrosive effect of the strong brine. Experience and good practice indicate 1 1-2-inch to 2 1-2-inch galvanized gaspipe, with any suitable size for a manifold. The brine in the main pump discharge should not flow over 200 feet per minute, and in the cooling coils not over 50 feet per minute, and the coil should be long enough to allow the brine to absorb enough heat to raise its temperature to that of the room. Enough coils should then be provided to keep the room down to the required temperature.

Gates should be provided to close off any room, or several sections of one room, in case they are not needed. They are also convenient in rough weather, or when the ship is listed, in order to keep the brine from all going to one room. The pipes should be rigidly supported, and, while screwed fittings are the most practical, they should be substantial and the joints well made. The frost should be kept off the pipes to realize the highest efficiency. A steel scraper curving half around the pipe answers, but, for comfort and convenience, should have a long, stout handle like a large gouge.

The ice tank should have well-sealed covers to keep the brine from spilling. The can system is preferable for shipboard. A most important item in connection with the ice is an efficient, reliable tackle for hoisting the cans. Small cans, not over 40 pounds, should be used, and, if provided with means of attaching the tackle, should be easily handled in the heaviest weather without danger or inconvenience. Getting the ice out of the cans is a source of great annoyance in most plants. Either hot water has to be taken into the ice house, or the ice has to be removed to the deck to melt from the cans. A good plan is to have a steam box to hold one can at a time, and fed by a half-inch pipe from the boilers and a valve at the box. After the can is removed, a tight-fitting cover may be fitted to prevent steam escaping into the ice room.

Regular racks or chests should be provided for spare ice, as it is disagreeable to have it sliding about the floor or stored in some inaccessible corner. Great care should be taken to see that the store rooms are well drained and somewhat ventilated. The necessarily wet, slippery floors make gratings of wood or rubber a necessity. Matting is not sanitary and iron corrodes rapidly.

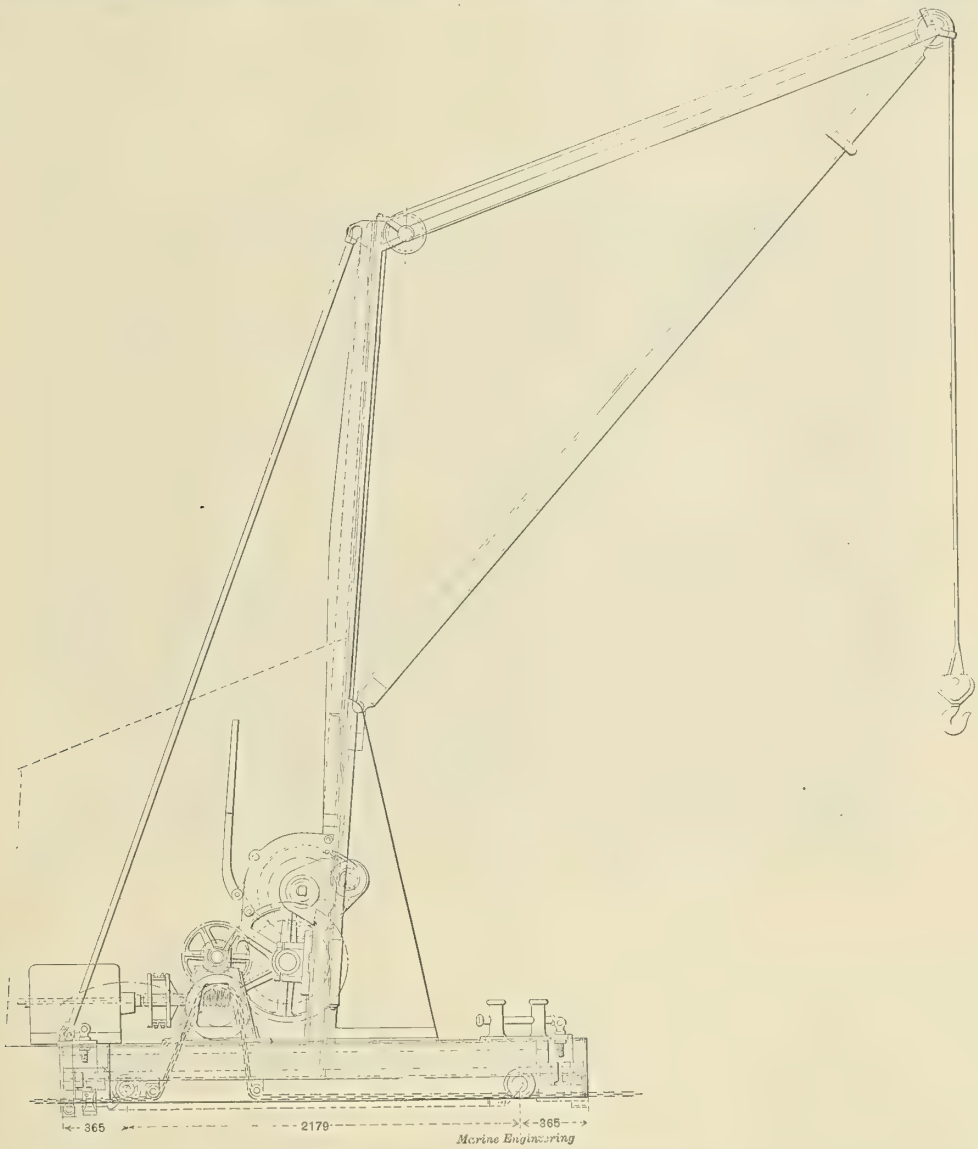
A great convenience in handling ice, provisions, water, etc., is a trolley track around the ceiling, with a trolley and pulley carrier running thereon. It is almost indispensable in rough weather, as heavy meat is very hard to handle when half-frozen. Brine should be made in a separate barrel kept in the ice house. This barrel should be about half-full of brine, and, as brine is taken out to supply waste, more salt and water may be added and the density kept constant by testing with a hydrometer. Salt should be added until it will float a potato easily, corresponding to 90° on the common hydrometer.

The ice rooms should be supplied with fresh-water pipes, electric lights, and means of rinsing down the floor. The doors should be thick enough to keep out the heat. Since they are necessarily very heavy, it is a good plan to have them well fitted with hooks, latches, and bars to hold them rigidly in any desirable position, as serious accidents may happen if they are allowed to swing. If some of these precautions could be observed, the refrigerating plant on shipboard would have a much better reputation among engineers than it now enjoys.

MODERN SHIPWAY EQUIPMENT, AND ITS FUTURE DEVELOPMENT.—I.*

BY TJARD SCHWARZ.

With the beginning of the development of iron shipbuilding, about the middle of the century, came new problems. The working of iron materials required machinery driven by steam power. The bending of frames, as well as the working of curved sheets of plating, required especial heating furnaces and arrangements. There came, therefore, the ship workshop, in which the plates and angles, partly cold, partly warm, were prepared, while at the building slip the assembling and riveting of the members followed. Here, furthermore, the separate structural members required various sorts of operations, which for the most part were carried out by hand. Also, at first, the transport of the prepared material to the building slip experienced, in comparison with wooden shipbuilding, but slight modification. The workmen carried the frames and plates, after preparation in the shops, on their shoulders to the building slip. These difficult and primitive methods of work lasted until about the eighth decade of the century, when use began to be made of cars on tracks for the transport of material, and of derricks for hoisting it to its place in the ship. The hoisting was carried on in the first place by hand, and later by means of steam winches. In the course of time the masts, with their booms, were increased to three on each side of the ship, and were operated, on account of their distance from the power station, by electrical drive. As an example, mention may be made of the electrical windlass of Blohm and Voss. This, on account of the simple change from hoisting to lowering, whereby the motor retains its direction of revolution, renders it especially suited for use about shipways.



CRANE AT KAISERLICHEN WORKS, WILHELMSHAVEN.

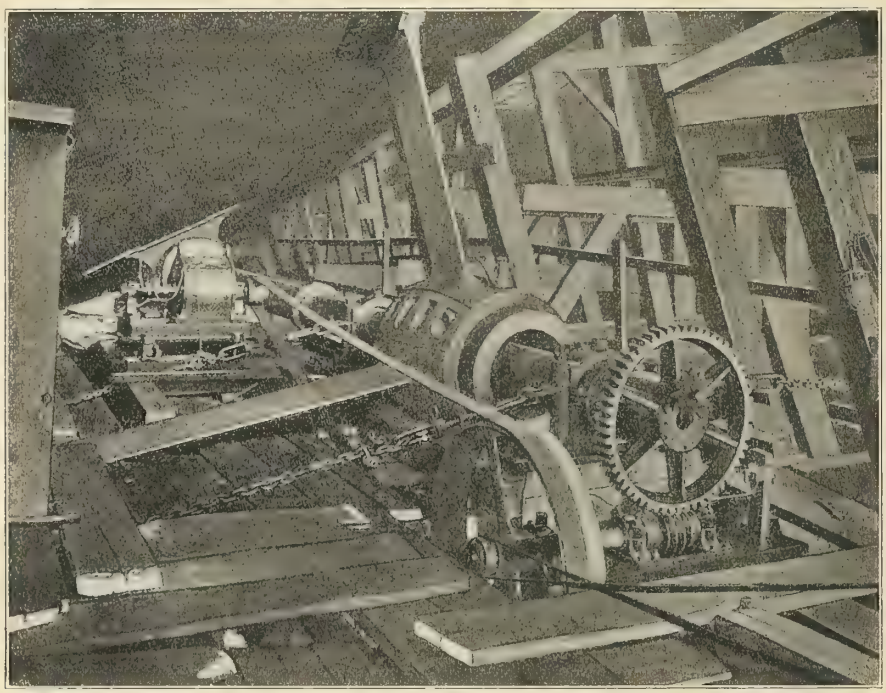
The beginning of the use of auxiliary machinery about the building slip was made by the Vulcan Works

*Translated and abstracted for MARINE ENGINEERING from the *Jahrbuch der Schiffbautechnischen Gesellschaft*, 1901.

at Stettin. The construction of a large number of cruisers (iron body with wood planking) induced the installation at these works, toward the end of the seventh decade of the century, of a line of shafting from the ship shed to the building slip, from which, by means of rope drives, portable boring machines were driven in order to drill the holes in the outer plating for the bolts of the wooden planking.

Close upon these drilling machines came the portable hydraulic riveting machines, which, with the method of building first developed on the Clyde, gave very good service for riveting the frames, floors, and beams in the frame shed. This as a whole was then erected in place at the shipway. In this manner the work was facilitated, because on the one hand the riveting on a level floor was easily carried out with hydraulic machinery, while on the other hand the transport of the material was simplified by the erection of the frame in one operation. There was also in England, at about the same time, a so-called shipway crane, a form of stationary derrick crane which, in the works of A. Stephens and Sons, was used to set into the ship heavy machinery and parts of boilers before the launch, but was not used for the construction of the ship itself.

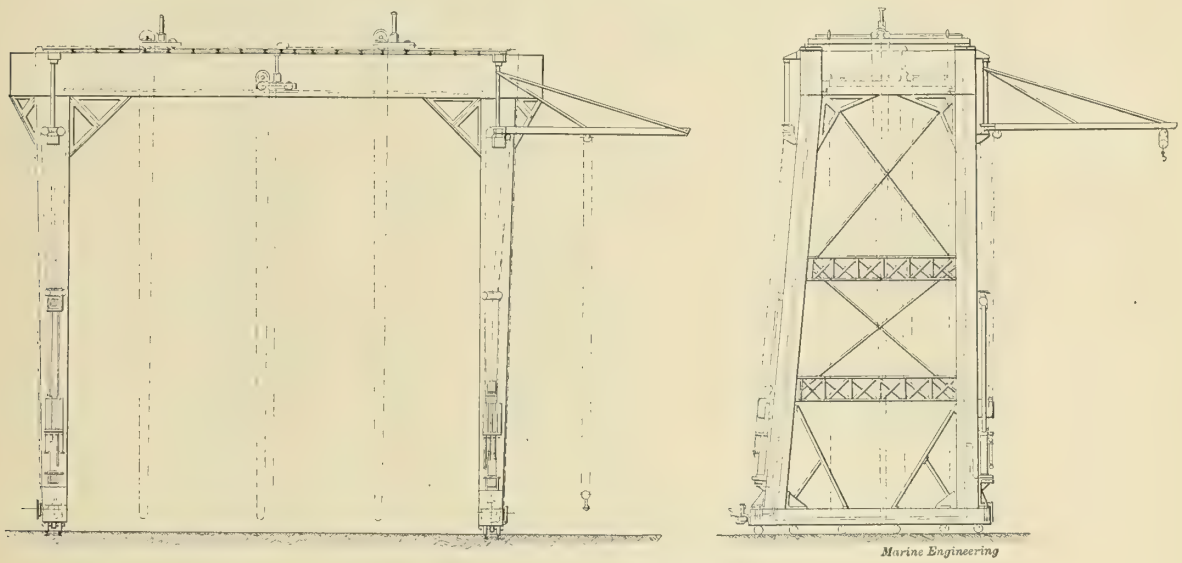
Then, later, the development of the electric transmission of power made possible a further step for the improvement of means of transport, as well as for widening the scope of machine work at the building slip. The installation from an electric central station of suitable wiring to carry the electric current to any desired place, and there by the help of portable motors to drive auxiliary tools, proved of so great value to the work at the building slip that in shipbuilding this electrical distribution of power soon took strong hold. It came about, furthermore, that the electric current was not only employed for the operation of hoisting machinery, and also for the driving of auxiliary tools, but also with the same distribution the very important requirement of lighting the ship throughout its inner compartments could be fulfilled. The extension of electric lighting throughout the entire shipyard, including building slips, increased also in notable degree the efficiency of operation of the yard, as in the winter months the shrinkage of the working time was, in large measure, prevented. Thus, where previously workmen on board must work by smoking oil lamps or candles, now arc lamps are provided, and the work, whether in day or night, can readily be carried forward. Furthermore, as the lower passages and compartments may be lighted by incandescent lamps, so the facility of working has become greater, and accidents are the less likely to occur. In order to give a general view of the extent to which electrical power for the work at the building slip may be employed, reference may be made to the more important features of the Imperial Dock Yard at Wilhelmshaven.



MOTOR-DRIVEN RIG FOR BORING SHAFT STRUT AT WILHELMSHAVEN.

The foundation of the electrical central station followed the laying of the keel of the battleship *Kaiser Friedrich III.*, and the plant was further increased upon the building of the battleship *Kaiser Wilhelm II.*, so that for the operations about the building slip altogether 17 motors were employed. Of these, two of 3 1-2 H. P. were employed solely for the transport of material, while the others were used for driving various machines. The transport of material about the slip is effected by two traveling cranes which run upon a "U" track. This track corresponds in slope to that of the slip, at a grade of 1:16. The motion of all the cranes results by means of a chain carried from a chain wheel on the crane. The reach of both the cranes measures 10 feet. The turning of the masts is by hand power,

while the hoisting machinery is driven by a 3.5 H. P. motor through worm and spur gearing. Motors are arranged to run in either direction and are provided with reversing switches and brakes. The peculiarity of the construction of the crane lies in the fact that it is arranged in two stages; that each crane first operates on the lower stage, which is at the height of the armor shelf of the battleship. As the construction is then carried further above, the crane then builds for itself its second stage, standing on struts and beams which are bound together above with the rails, and which reach from stem to stern. Through the construction of the crane in two stages, it follows that it is necessary to lift the material only so high as its place in the construction of the ship makes necessary. Each crane, which weighs in round numbers 5 tons, has a lifting capacity of 3 tons, with a speed of 13 feet per minute. The material is brought alongside the building slip by means of small cars, and is then taken direct by the crane and carried to its place



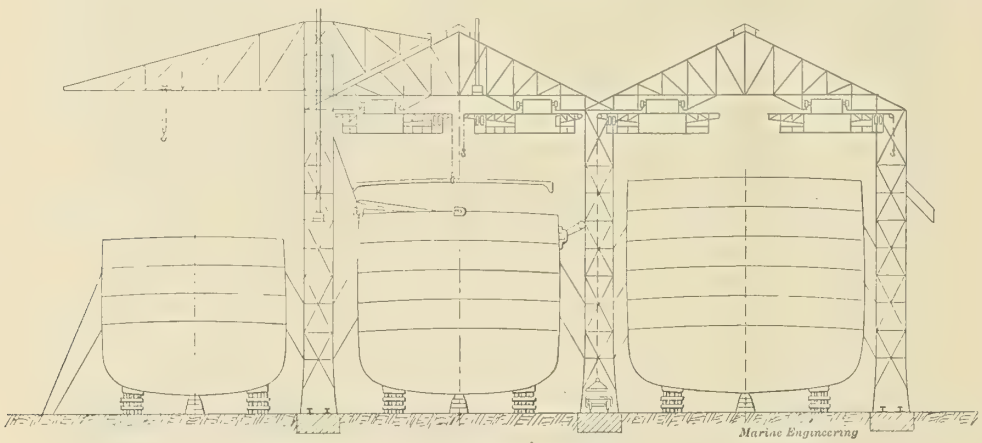
CRANE AT HARLAND AND WOLFF'S YARD.

in the ship. For the erection of beams both cranes can work together. Of the remaining motors, one of 9 H. P. capacity is used to drive the machine for boring the stern posts, shaft struts, and bearings. The comfortable and easy mounting, the quick and uniform operation of the motors, as well as the economical application of electric power, have resulted in quickly displacing the steam traveling crane formerly used for these purposes. Since for these operations of the motor its use is required for only two or three weeks, for the remaining time it is available for driving small reamers or drills which are used in connection with the fitting of transverse members of the structure. Six motors of 3 1-2 H. P. are used for driving the boring and tapping machines required in connection with the numberless holes in the armor deck. The 3 1-2 H. P. motor drives a short transmission shaft, from which, by rope drive, the driving shafts of three to four boring or tapping machines are operated. After the fitting of the armor deck, motors are used for driving manhole-cutting machines, or portable machines for the cutting and sawing of deck openings, or for the driving of portable cold saws for the cutting of beams, angles, etc. The small weight of the motor makes it easy of transport, so that it can be utilized for that part of the work where most needed. Certain motors, however, remain stationary during the entire time. Of such are a 25 H. P. motor for driving the air compressors for compressed-air tools, as well as two little motors for driving centrifugal blowers for giving blast to the rivet furnaces. The rivet boys are thus relieved from blowing the furnaces and can give their entire attention to the heating of the rivets. For the ventilation of the double bottom portable motors are also used, and it thus appears that electric transmission of power possesses great advantages even with reference to the health of the employees. In conclusion, mention may be made of the electric-driven centrifugal pumps which are used for filling the separate water-tight compartments with water from the harbor, and, after the same, for pumping them out. For the first operation the pump is erected on the quay wall; for the last, on board ship, so that the height of lifting the water is small. For merchant ships, furthermore, electric-driven deck-planing machines have been found of special use.

These examples may serve to illustrate the manifold applications of electric power for the work at the building slip. For many purposes, however, electricity has a powerful rival in the modern type of hydraulic or compressed-air tools, which likewise draw their power from a distant-placed central station. Especially is this true with regard to mechanical riveting, which may be well done with hydraulic power or by means of compressed air. Electric-driven riveting has only recently come into use. Further, the pneumatic hammer, which is also used for chipping and calking, stands at the present time without a rival, while the pneumatic boring machine strongly rivals those driven by means of electric power.

Hydraulic riveting machines, which in England first came into wide use for shipbuilding purposes, have in recent times become almost a necessity, especially with the recent great increase in size. The thickness of sep-

arate items of the structure must in consequence be so increased that, for example, keel plates and sheer strakes of the outer shell exceed 1 inch in thickness. With such material hand-riveting is inadequate, and the excellence of the work is wholly dependent on the strength and skill of the riveter. For this reason the firm of Harland and Wolff, in building the *Oceanic,* concluded to erect a powerful gantry crane, which was especially intended to provide for the transport of a suitable number of portable riveting machines in such manner that in all parts of the ship they might be used to good advantage. Such an arrangement is only possible in the mild climate of Ireland, where winter frost seldom gives trouble and freezing of water in the tools is not to be expected. The yard of Harland and Wolff has three large gantry cranes for the three building slips. The opening in the clear between the pillars measures 90 feet, and the height of the rails to the lower edge of the cross-beams 95 feet, so that they may pass over the largest ships. The cranes run on two rails 577 feet long, which correspond to the slope of the slip, 1:24 in the arc of a circle. Each gantry crane carries three hydraulic traveling cranes of 10 tons capacity, two on the upper and one on the under edge of the cross girders, to which the hydraulic riveting machines are hung by means of chains. At the four corners of the crane are, furthermore, four derrick masts, each one of four tons capacity, operated by hydraulic power for hoisting and swinging. The same are used for carrying electrical boring machines, as well as for the erection of frames and for handling shell plating.

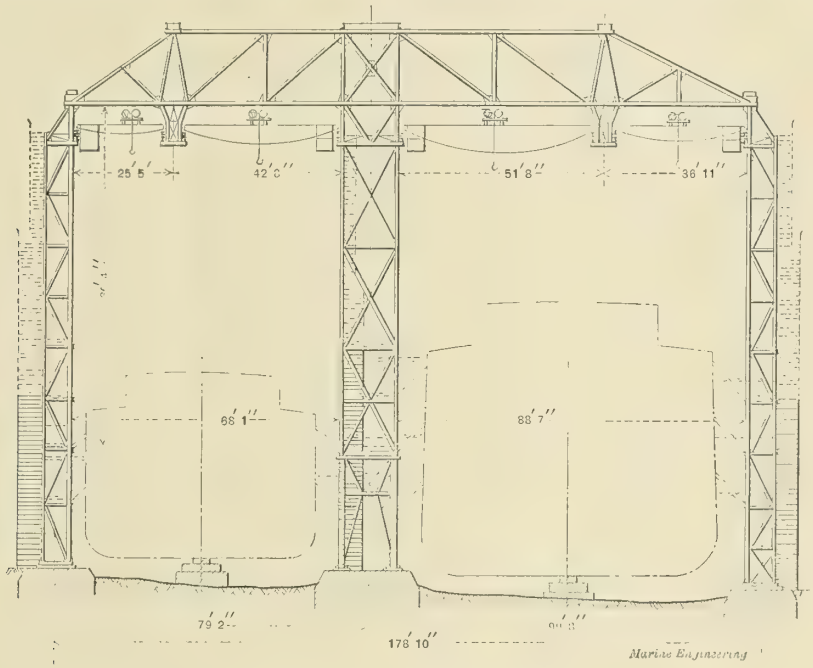


SHIPWAYS AT THE WORKS OF SWAN AND HUNTER.

Compressed-air appliances are especially of American development. They are at the present time largely used in America and in American yards, and are more especially applicable for the work at the building slips. In German yards compressed-air tools in recent years have found more and more use since the pneumatic hammer has been improved with reference to the jar on the operator. Also the pneumatic riveter, since it is similar in operation to the hand hammer, possesses alone the capacity for riveting mechanically the shell plating.

From the previous developments in these lines, and having in view the present condition as regards the use of electrical power and the application of hydraulic riveting machines as well as compressed-air tools, such as riveters, boring machines, chippers, and calkers, as well as all manner of auxiliary work at the building slip, it is clear that further developments along these lines are to be expected. The building slip is no longer a building and erecting place. It has rather, in the widest sense, become a workshop in which the whole ship's construction is erected, riveted, and completed. Since, furthermore, with reference to every workshop, it is clear that it should be brought under a weather-proof building, so that on the one hand the tools should not suffer and on the other the workmen should be protected against the weather, the simple conclusion follows that the building slip should be covered over and the construction closed in on two sides. The building slips of warship yards in the time of wooden shipbuilding may thus again be brought into use, although somewhat improved in their modern form. While the old wooden ship house was without top light, and was intended simply to protect the building material, the costly frames, and planking from dampness, the modern iron-and-glass-covered ship house is not intended so much to protect the building material as the costly machinery, and to provide for the workman a healthful, dry, and, in winter, a warm working place. I know that through this new construction the capitalist is heavily laden, and that the capital must be increased in order to provide for the cost of this new construction. I hope, however, to be able to show that a building slip workshop, when properly arranged, may be able to pay and to provide for the necessary interest and depreciation on the investment. For, with such a building provided, it is a simple matter to equip it, as with modern workshops, with suitable and efficient lifting devices, with traveling cranes, etc., which are essential for suitably carrying on the work. These lifting devices claim, moreover, special attention when it is remembered that the weight of the hull at launching, and thus up to the time at which the ship leaves the building slip, in the case of modern ocean liners as well as with the combined freight and passenger steamers, is 9,000 tons and more. It must be remembered that in a closed building slip lifting machines of every sort and in every location can find use, and that even hanging of heavy hydraulic machines, as with the gantry crane of Harland and Wolff, is possible; that, furthermore, the scaffolding for the

riveting of the shell is easily arranged by the use of the structure of the building, and that in many ways it becomes easily possible to make such a construction useful to the fullest extent. In winter it also results that with such a roof over the building the work is not deranged by snowfall, and walking over the scaffolding and parts under construction is accomplished without difficulty. The only drawback, the slight darkening of the building slip, should not be considered serious, since electric lighting is provided for all parts of the ship. It is, moreover, a fact of importance that there is difficulty in obtaining a sufficient number of apprentices for shipbuilding, while the engine shop is not troubled with any difficulty of this character. Young people prefer to work in a closed shop which provides shelter against rain and cold, and in which, furthermore, the work is restricted almost entirely to hand-



OVERHEAD CRANES AT THE VULCAN YARD.

work operations, since suitable means are provided for the handling of heavy materials.

The first covering over a building slip was installed by the firm of Swan and Hunter on the Tyne. The whole establishment is built according to the ideas of Mr. G. B. Hunter and is suitably protected by patents. The special features are seen in the section through the slip and in the plan of the crane on page 350. In this construction a roof is placed over two slips, which at the same time serves to carry tracks for a traveling crane serving a third uncovered slip. The roof has a length of 500 feet by a height in the clear of 80 feet. It is built in the main of channel section posts bound together with diagonal strut and tie pieces. This framework and general type of construction provides readily for the arrangement of struts for supporting the hull, for the operation of riveting machines, and for horizontal runways for the use of rivet boys. Above, the posts are bound together by the members of the roof construction, which have sufficient strength to carry five electrical traveling cranes of three tons capacity. The width of one slip in the clear is 78 feet, and of the other 82 feet. The posts of the roof at the bottom are so constructed that between their structural members there is room for a narrow-gauge railroad. Material for the ship can, in this manner, be taken by the crane either at the head of the slip or along either side of the ship and carried to the place where needed. This slip has two tracks for the cranes, which are extended over the whole length of the roof. The cranes are operated by an electric motor, and are provided for hoisting, traveling, and turning of the cranes through gearing as well as through belt driving. Near the tracks for the cranes are placed, also, a number of rails for carrying riveting machines. The roof is for the most part covered with glass, as well as the upper portion of the side walls. Below, the walls to a height of 33 feet are open, and in winter are covered temporarily by canvas or wooden panels. In such a slip, in 1899, the *Ivernia,* at that time the largest combined freight and passenger steamer which had been built on the Tyne, was in nine months constructed up to the condition for launching, and, according to the statements of the owners, it was possible to build into the structure in that short time a weight of 8,000 tons. A similar appliance is found at the Union Iron Works in San Francisco, and here for four slips. The first construction was built in 1884, the others later, and all of wood. The latest is 408 feet long, 85 feet in width, and 78 feet in height, and the roof ridge has the same slope as the slip. At the head end of the construction are found three cranes 50 feet in length, while at the water end is found one of the same length, so that over a total length of 500 feet appliances for hoisting and transport are at hand. Under the roof two traveling cranes are arranged which, since the ridge of the roof is 3 feet out of the middle line, possess different spans, so that the outer end of the longer crane

extends beyond the middle line of the ship. Since the track of the cranes is on a slope, it is necessary to provide special means for their locomotion. This is brought about through the winding and unwinding of ropes on two drums at the ends of the cranes. These cranes have a traveling speed of 200 feet per minute; the travel has a speed of 100 feet per minute, and the hoisting speed is the same. The capacity of the crane is 5 tons. The wooden pillars of the roof are provided with holes, so that at any convenient height means may be found for the support of the ship staging.

Note may be made of the manner in which riveting machines, whether hydraulic or pneumatic, are supported. To this end nine pillar cranes are mounted on the standards supporting the roof. From each two of these cranes is hung, by rods, a beam to which the riveting machines are hung by means of a traveling carriage. In this manner the riveting machines may be placed wherever required and at any level in the ship. Through this arrangement it is furthermore possible, even during the operation of the rivet machines, to use the traveling cranes for carrying or hoisting material. As the wooden pillars are spaced twelve feet apart, the approach of material from the side is not practicable, and all large members must, therefore, enter at the head of the slip. The three pillar cranes at the head of the dock are also available for handling riveters for working on frames.

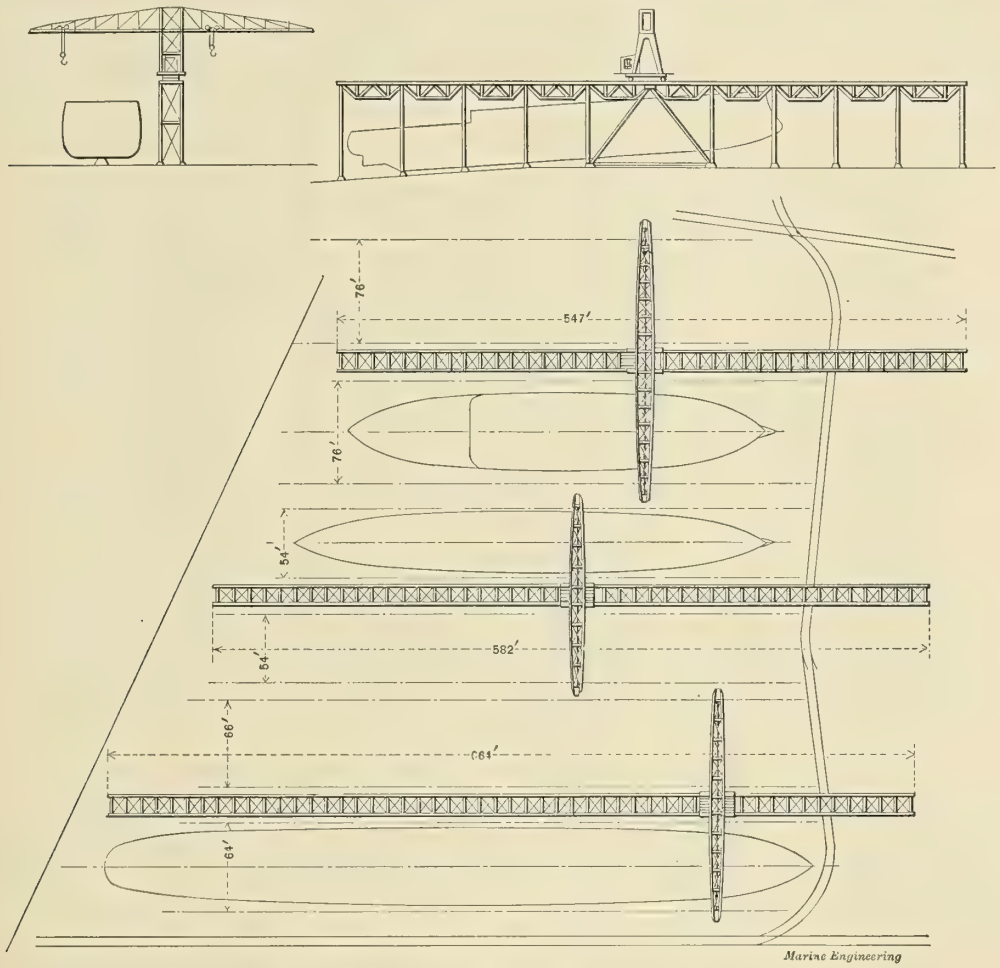
In Germany slipway cranes are not yet in use. The Krupp Germania Works, in Kiel, have designed for their new dockyard a roof and traveling crane. The Vulcan Works are about to provide slipway cranes for their four large building slips for mercantile construction. The entire equipment for each building slip stands on a kind of shed-like structure, which carries, by means of four strong traveling ways, two traveling cranes of four tons capacity. The traveling cranes have different spans, 62 feet, 43 feet, and 31 feet, similar to those of the Union Iron Works, in order that one of the cranes may be able to cover the middle line of the ship, and the cranes are built on the three-motor system and take current at 500 volts. The speed of lifting is 33 feet per minute, for the travel of the trolley 66 feet, and for the travel of the crane itself 260 feet per minute. The control station for each crane is at the side, so that the trolley can travel to the extreme run on either end. The arrangement of the cranes is in such manner that all objects received at the upper end of the slip may be taken by the crane and transported to the place where required. The height of the crane structure is also very large, in order to give sufficient room between the upper deck of the ship and the crane. The building is also provided with horizontal platforms, which are reached by suitable steps. These are constructed with sufficient strength so that the ship may be braced against them. Between the upper timbers on this platform are further fastened vertical posts which provide for staging for the riveters, while between these wooden struts may be inserted and made fast.

Besides these cranes, as above described, special handling cranes are in use in many of the large American yards, such as those installed in the William Cramp and Sons' Ship and Engine Building Company, Philadelphia, and in the Newport News Shipbuilding and Dry Dock Company, Newport News, Va. These are cranes of the cantilever type, made by the Brown Hoisting and Conveying Company. The cranes run each upon tracks carried upon a lofty framework structure, which is located between two slips in order that the crane with its traveler may serve both sides. While the traveler is run out to one side, at the same time on the other side a counterweight keeps equal pace, thus equalizing the forces. The crane can, therefore, pick up a load on one side at a time only. For the operation of the crane a 50 to 80-H. P. motor serves, located in a house under the traveling girder, and from which the power for moving girder, traveler, and for lifting the weight is derived through friction coupling. The speeds of operation of the crane are especially high. Thus the speed of hoisting the weight is 250 feet per minute, the travel of the main crane 650 per minute, and that of the cross trolley can be made still faster. This shipyard possesses three such cranes, with corresponding tracks, as follows: One crane for two battleships, each of them of width up to 76 feet, capable of hoisting 4 1-2 tons at a distance of 95 feet, or 12 1-2 tons at a distance of 60 feet, to a height of 92 feet from the ground; second, one crane for two merchant ships up to 66 feet in width, with a capacity of 3 tons at 78 feet, and 10 tons at 46 feet, at a height of 95 feet; third, one crane for two cruisers up to 54 feet width, with capacity of 12 1-2 tons at 39 1-2 feet to a height of 85 feet. The Brown hoisting crane can be used for handling various heavy weights, and serves not alone for the transport of the lighter parts of the ship, such as plates and angles, but also for the heavier forgings, stem, stern posts, etc.

Regarding the advantages of such cranes, weights of 12 1-2 tons and downward to single angles and plates of a few hundred pounds weight with correspondingly higher speed may be hoisted and carried. The chief disadvantage lies in the fact that, as a rule, only half the crane can be in use at one time, since it is intended to serve two building slips. Even if the hoisting as well as carrying the piece to its place in the ship can be carried out in one minute, the crane must remain at this location often some eight or ten minutes for adjusting and fastening the piece, so that it is not always possible to handle promptly all material for the two ships under construction at the same time. With an average weight of 1,000 pounds, with 10 minutes for securing in place, the maximum capacity of one crane will be 30 tons per day for the two ships.

A more rapid rate of work would be difficult to bring about, and the considerable distance between the operator of the crane and the workmen on the ship makes it difficult to maintain a quick understanding between the two. In addition, it should be remembered that the elevated structure cannot be used for supporting the scaffolding about the ship, and the provision of a roof over the crane is also not feasible. In comparison, the style of traveling crane previously referred to presents important advantages. Thus, for each ship, as we have seen in the illustrations given, two cranes are ready for use at the same time with capacity from 3 to 5 tons, thus providing for all parts of the structure excepting the stem and stern posts. For such purposes the two cranes may be operated together. As the crane operator is located directly over the workmen at the ship,

a ready understanding with the latter is possible. The necessary structure for such a crane can furthermore be used for supporting the shores of the ship and the surrounding scaffolding, for the support of riveting machines, etc. This structure can furthermore, without serious cost, be covered with a roof in order to protect the machine and workmen. It is clear, furthermore, that for the climate of Germany such constructions with protecting roof have special advantages. When, therefore, the Germania-Werft, in Kiel, undertook the construction of a building-slip crane of this character, and, in addition, provided a massive structure with dock



BUILDING WAYS AND GANTRY CRANES AT CRAMP'S SHIPYARD.

gates, in order on the one hand to keep the height of the ship lower for launching, and on the other to be able to provide for the launching with greater care and security, the natural development would seem to point toward the abandonment of the inclined plane and the construction of a shallow, level dry-dock. Such a dry-dock, with a depth of the sill some 15 or 20 feet below the normal level of the water, provided with complete roofing, should without doubt provide the building place of the future for war and mercantile marine. The chief advantage which such a dock brings is in regard to the launching. For the laity—that is to say, for those not accustomed to the work in a shipyard and who delight in the spectacle of a launch—such an advantage would have small value. The shipbuilder, however, who, through his familiarity with such work, must take upon himself the care and responsibility of such an operation, would gladly be relieved from the anxiety which such occasions force upon him. Even if the provisions for a launch according to the laws of mechanics is a simple problem, and even when all computations and every provision have been accurately made, still it seems unnatural that the builder of the ship should give it over entirely out of his hands and into the control of the elementary forces of nature. And, in fact, in the history of shipbuilding, we find a sufficient number of examples which teach that misfortune in launching is not unusual. If the ship sticks on the ways and does not start at the prescribed instant it is not necessarily so serious a matter. The expectations of the invited guests are simply disturbed, and their patience in the meantime is simply called upon to undergo a moderate test. If, however, the ship first starts off freely and then comes to rest, or should the ship capsize on entering the water, then loss of life and injury to the material of the ship's hull may follow, which at one stroke will sweep away the profits of the unfortunate builder. This uncertainty in launching has induced private builders to insure large ships against accident in launching, and the premium, which has reached $3,750, shows clearly

that the result of the launch is not so sure as one in general may be inclined to believe. The difficulty of a launch increases, however, in marked degree with the increase of launching weight and with the length of the ship, and especially for those yards where it is necessary to launch into a river of limited width. Thus, for example, the English firm, Laird Bros., for some years have used their stone docks for the building of warships and mercantile steamers, and at the royal dock yards in Portsmouth and Chatham the dry-docks have been used for building ships of the line, while in Germany the firm Seebeck, in Bremerhaven, used similarly a wooden dry-dock for the construction of the steamship *Trier*. These examples relating to the construction of ships in dry-docks should serve as an indication that the advantage of such mode of construction, as compared with the use of the ordinary building slip, can scarcely be denied. How much more important become these advantages for the building dock when it is constructed especially for this purpose, in which case the special depth of the ordinary dry-dock is not required, and only sufficient depth is given to allow the ship in launching condition to freely float over the dock sill. In such case the space required for the dock is very much decreased, and the work of preparing foundations is very much simplified. If, then, such a building dock is covered with a protecting structure, and provided with suitable handling mechanism, provision would be made for an arrangement of work which should fulfil the highest demands of future construction. It may be urged against such a type of construction that it is too expensive, that such a manner of carrying on the work would require such an increase in working capital as to give rise to serious difficulty to insure a suitable return on the investment in periods of business depression. It would carry us beyond the limits of the present purpose to discuss in detail the cost of such an installation, and it must suffice to mention briefly the chief points in favor of the building dock.

(1) Elimination of the launch and the uncertain and serious expenses connected therewith.

(2) Elimination of much of the work of arranging the building slip.

(3) The width of river or channel is a matter of no importance, and there will be no expense required for dredging and widening the existing channel.

(4) The insurance premium is no longer necessary.

(5) Work on the ship can be carried on until the last instant.

(6) All transverse members of the ship are built in an upright position.

(7) The support of the ship is at the same level, and, in consequence, under the fore body, much lower than with the building slip.

(8) As the keel of the ship is located somewhere about 15 feet below the water line, and therefore some 16 or 17 feet lower than the level of the building slip, it follows that the building material has, on the whole, to be lifted but slightly.

(9) The scaffolding is simpler and lower.

(10) The time of the launch or exit from the dock is independent of the conditions of the water, as the ship can be hauled out of the dock at any time.

(11) With reference to the covering over the dock, it may be noted that the height of such structure is very much less than with the building slip, and that for its foundation the walls of the dock may be employed.

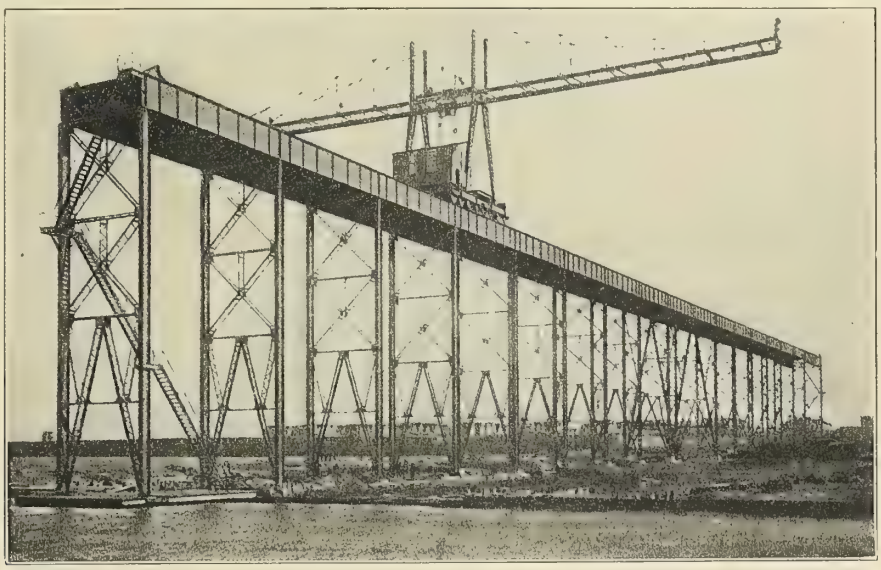
The disadvantages, the ventilation and drying of the dock, and the increase of electric lighting, with the modern extension in the system of electrical distribution are not of so great importance. With reference to the financial aspect of this question, if one considers a ship like the *Ivernia* (13,000 gross register tons), or, on the other hand, a ship of the line or a large cruiser of ten to twelve thousand tons displacement, and if one considers that ships of this size in the course of nine months can be completed sufficiently to float, it follows that for this time and for such ships there would be a saving of at least $30,000, or, for twelve months, say $40,000. If the expense of maintaining the dock is estimated at $6,000, there results a gain of $34,000 a year. If the construction of a building dock per square foot is reckoned at about $10, the cost of a dock 650 feet long and 85 feet broad would be about $550,000. If the decreased cost in roofing and covering, as compared with a building slip, is estimated at $50,000, there remains the sum of $500,000 to be charged against the construction of the dock. The saving above noted would pay the interest on such a sum, even at 6½ per cent. Further consideration should be given, however, to the fact that since the construction of the ship in the dock may be carried forward much more rapidly than in a building slip, the productiveness of the invested capital as a whole is thereby much increased.

After the floating or launching of the ship the second period of construction begins. It is of the greatest importance during this second period that means for transportation should be ample and so arranged as to work with the highest possible speed, in order to provide for the great variety of articles, as well as tools, which must be transported back and forth. In most dock-yards this relation between the workshops and the ship has not received adequate attention. Very often the machine shop, as well as the boiler shop or pipe-fitting shop, are far removed from the building slip, and often separated by a street, or in some cases such shops are located at a different place entirely and are only connected with the shipyard by a railroad. As a rule, furthermore, the weights of the boilers and parts of the engine are so great that the usual means of transportation are not sufficient. It becomes therefore desirable, so far as possible, to locate such shops conveniently to each other, and then for their suitable connection to provide some form of traveling crane. This close connection has the further advantage that the various shops and tools can be better united under one management, so that different tools may be better utilized and the efficiency of the administration increased. Why, for example, should the shipbuilding section be provided with a forge shop and the engineering section with boiler and forge shops independently? Why should these three shops not be united in one? In all three are to be found, in similar fashion, smiths' fires, heating furnaces, steam or air hammers, and in the boiler shop in particular the operations on the plates are similar to those on the heaviest of the plates required for the ship. In such case use can be made in both general departments of the work of rolls, plate planers, boring

mills, and hydraulic riveting machines, and for all these implements a central power station can be provided. Why must, further, the fitting shop for the ship be separated from the general or engineering machine shop? Most of the tools in the two shops are entirely similar. Through a centralization of all these tools in one shop a notable increase in efficiency may be obtained, and the details may be advantageously administered with reference to the work as a whole. The same is true in connection with the coppersmith's shop and paint shop. As to whether any advantage would arise from a combination of the carpenter shop with the patternmaker's shop, there may be still a difference of opinion, since the carpenter shop should be located conveniently to the water front, while the pattern shop is better located in the neighborhood of the foundry. The chief thing remains that the separate shops should be arranged, so far as possible, conveniently to the dock on the water front, and that suitable arrangements should be provided between the shops and the ship. We are thus naturally brought to the consideration of recent improvements which the advances in hoisting machinery have provided in the form of special types of dock cranes.

The method previously employed for transporting heavy weights, such as boilers, from the boiler shop to the dock, usually involved the use of some form of trackway connecting the two places, upon which traveled a suitable car. By means of a crane in the shop the boiler was loaded on the car, and was thus transported to the dock front under the dock crane or shears. The use of such tracks in a shop has many disadvantages. With the modern electric-driven traveling crane, which reaches a speed of 300 feet per minute, it is now a simple matter to pick up an article in any part of the workshop and carry it to the shop exit. If the latter is provided with an opening for the crane, and the track is lengthened outwardly above a track on the ground, it becomes an easy matter to deliver the weight direct to a car standing upon the tracks outside, without any necessity for the latter entering the shop itself. Such cranes are provided at the Donnersmarkhütte, in Oberschlesien, in their boiler shop. The slide for covering the opening necessary to allow the crane to pass in and out is operated by hoists from below. If, in this manner, a collection of shops is connected together, the transport of materials to the dock crane, or from one shop to another, may be carried out in the simplest possible manner. Naturally, with the present development in electric traction, electric locomotives will find a use in effecting transport of material in this manner.

(To be continued.)



GANTRY CRANE AT NEWPORT NEWS YARD.

Pacific Terminal.—The great Northern Railway Company has decided to make Seattle, Oreg., the eastern terminal of the line of Asiatic steamships.

A Pension at Shipyard.—The Vulcan Shipbuilding yards at Stettin, Germany, have inaugurated a pension fund whereby employees, on the payment of an initiation fee and annual premiums, receive a pension upon their retirement from the works. In case of death the pension is paid to the widow or children. The shipyard pays a premium equivalent to that paid by the members.

Inspector of Hulls.—The United States Civil Service Commission announces that on July 8 and 9 examinations will be held in various cities throughout the United States for the position of Inspector of Hulls in the Steamboat Inspection Service at Evanston, Ind., at a salary of $1,200 per annum, and other similar vacancies as they may occur. For further particulars address the Commission at Washington, D. C.

Oil Fuel.—The ships of the American-Hawaiian Steamship Company are to be converted into oil burners. The steamship *Nebraskan* of this company, recently launched from the New York Shipbuilding yards, and now on her way from New York to San Francisco, has already been equipped with oil-burning apparatus and upon her arrival at San Francisco will discard coal. The vessel will take fuel oil at New York and San Francisco, and also replenish the supply from a tank ship stationed in the Straits of Magellan.

Wreck of the Acara.

The accompanying illustration, as reproduced by permission of the *Brooklyn Eagle,* shows the British steamer *Acara,* which went ashore between Fire Island and Coney Island on March 1. The place where the ship grounded is unprotected by lighthouses, and at low tide there is but 18 feet of water as far as a mile and a half from the shore. Many vessels have been wrecked along this coast.

The *Acara* was bound from Shanghai to New York with a cargo of tin, silk, tea, and spices. The vessel struck head on, and the force of the waves soon drove her to the north end of the beach, and as the entire crew of sixty were composed of Malays, Hindus, and Chinese, the greatest excitement prevailed, which for some time the officers were unable to quell.

The wreckers were soon at the scene and unloading the cargo, most of which, however, was a total loss owing to damage by sea water. The ship could not withstand the strain of the tremendous seas that broke against her sides and dashed over her decks. The ship gradually sank in the sand and split in two, as shown in the photograph. An attempt was made to take the vessel off in halves, as she is comparatively new. The attempts, however, to salve the ship were unsuccessful, and the wreck has been abandoned.

THE STEAMER ACARA SPLIT IN TWO OFF THE LONG ISLAND SHORE.

The *Acara* was built at Newcastle four years ago, and was 380 feet long, 47 feet 4 inches beam, 29 feet deep, with a gross tonnage of 4,193 tons.

Webb's Academy.—The eighth annual report of Webb's Academy and Home for Shipbuilders, Fordham Heights, Bronx borough, New York city, shows the condition of this institution to be flourishing and the work carried on by the students to be of increasing importance. The members of the marine engineering section, besides their usual studies, have designed marine engines and boilers; and those in the section of naval architecture have worked out designs for fast vessels. Many visits have been made to neighboring shipyards for the purpose of study. The members graduated from this institution have secured good positions in various shipyards.

The Selection of Lubricating Oil.

Oil intended to lubricate bearings, slides and other rubbing surfaces should be invariably pure mineral oil, devoid of any vegetable or animal fat. Vegetable oils have no lubricating properties whatever, and oxidize at a comparatively low temperature, becoming thick and gummy; animal oils also thicken and become sticky and gummy when exposed to the influence of the atmosphere and the warmth of rubbing surfaces. Animal and vegetable oils are often compounded with a mineral oil in order to produce an engine oil having high viscosity and fire test; such a compound should never be accepted at any price. In order to test engine oil for "loading," put a little caustic soda or soda ash solution in the oil and shake it up. If it clouds up and looks soapy this is an indication of animal oil.

Paraffine is also highly objectionable. A convenient test for paraffine is to put a bottle of the engine oil on ice for fifteen or twenty minutes; if the oil becomes cloudy, it is loaded with paraffine and should be rejected without further argument or investigation. Engine oils having an opalescent green tinge when held up to the sunlight, instead of appearing clear yellow or red, are adulterated with either kerosene or some lighter hydrocarbon, which is not a lubricant and which volatilizes as soon as it is warmed by the friction of the bearings. Any engine oil, therefore, which has the slightest tinge of opalescent green should be rejected. Engine oils for high speed should show a viscosity of at least 170 and should range from that point up to 195 at an ordinary temperature, say 75°. The oil should have a specific gravity of about 30; it should not be under 29 nor over 31. The flash test should be between 400° and 440° Fahr.

Cylinder oils for use in connection with a cylinder where the steam pressure is less than 100 lbs. per square inch should show a fire test not less than 590° nor more than 630°. For pressure over 100 lbs. and up to 200 the viscosity should be from 640° to 660°. The specific gravity of a cylinder oil showing a fire test of 600° should be from 26 to 27, and for a fire test

of 660° the specific gravity should be about 24 to 25. Unless there is considerable moisture in the cylinders, cylinder oil should not contain any animal oil, and vegetable oil should not be used under any consideration. If animal oil should be necessary, acidless and refined tallow oil should invariably be used. For steam pressures of 100 lbs. or less, 8 to 10 per cent. of tallow oil may be compounded with mineral cylinder oil; and for pressures of 100 to 200 lbs., 3 to 6 per cent. may be used. Common lump tallow should never be used for compounding, as it contains acid which attacks the metal of the cylinder walls and leaves charred particles in the steam.

An adulteration commonly found in cheap grades of cylinder oil is wool fat, which is used to cut the gummy ingredient and give the oil a good flow in a cold test. Wool fat causes separation and a thick deposit in the bottom of the barrels, and results in the same charred deposit in the cylinder as lump tallow.—*American Electrician.*

Auxiliaries of the Korea.—In describing the auxiliary machinery of the *Korea* and *Siberia* in Marine Engineering of May, the third circulating pump should not be used in connection with the first of the list of pumps on page 212, as the main air pumps are separate from the circulating pumps. There are, however, two auxiliary horizontal, simplex air and circulating pumps, each having a 10-inch steam cylinder, 12-inch cylinder, 12-inch water cylinder, and 12-inch stroke.

Replacing the Bottom Plating of a Steamer.

The British steamer *Wilster,* which grounded on the beach off Rockport, Mass., some weeks ago, and was illustrated in Marine Engineering for April, has since undergone repairs at the John N. Robbins Company, Erie Basin, Brooklyn, N. Y., of a very extensive nature. The accompanying illustration of the bow plates shows the character of the damage sustained to her entire bottom.

As stated, the vessel stranded on the beach and remained there for several days during more or less stormy weather. The weight of the ship resting on the soft sand bent the plating between the frames so that the bottom was corrugated from bilge to bilge for almost the entire length. At the bow the shoe plate was badly jammed and twisted, and the stern frame was lost from the shoe to the 11-foot draft mark, carrying away the rudder with it.

DAMAGED BOTTOM OF THE STEAMER WILSTER.

All the bottom plating had to be taken off, some plates were rerolled, but most of them had to be replaced. The toes of the angle frames were heated and bent back without the frames being removed. The vessel was towed from East Boston, where she was first docked, to this port. The contract was $39,500, and the time allowance 35 days.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 126 vessels of 34,139 gross tons were built in the United States and officially numbered during the month of May, 1902.

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ACCORDING to recent reports, the experiments regarding the use of oil fuel for naval purposes, which are being carried on in Washington under the direction of Rear Admiral Melville, are meeting with gratifying success. For many years experiments along these lines have been carried on in a somewhat desultory way. It has long ago been shown, of course, that oil fuel under boilers could be burned and burned with reasonable efficiency. This has been shown beyond question with stationary boilers and with a considerable number of cases in the mercantile marine using fuel of this character. The chief difficulty which has been experienced with its use for naval purposes has been in connection with forced conditions. It has always been possible with oil fuel to obtain a high rate of evaporation per pound of fuel. The ratio of evaporation as compared with coal has often been stated at about 7 to 4 as representing the results under good average conditions. As compared with coal, therefore, there is a great increase in evaporative efficiency per pound of fuel. It has not been found practical, however, to force the combustion of oil to the same extent as that of coal, and in consequence the steam produced per square foot of heating surface or per pound of boiler under forced conditions with oil as fuel has not compared favorably with the results realized from coal. For naval purposes it is, of course, imperative that the boilers be capable of furnishing the utmost per unit of surface or weight, as these are the conditions existing in time of battle. For cruising conditions it is also necessary that due weight be given to the demand for economy per unit of combustible. It has been the difficulty of combining these two kinds of economy which has thus far worked against the wider use of oil for naval purposes. According to the preliminary reports regarding the present experiments, however, there seems to be a reasonable hope for improvement along these lines and for the development of greater capacity with oil fuel per unit of surface or weight. According to the preliminary statements, tests have been made under air pressures of 1 inch and 2 inches with a boiler of the water-tube type which had been previously subjected to exhaustive tests with coal as fuel. The results in both cases gave a greater output of steam with the oil than with the coal. In these tests questions of economy per pound of fuel were given no weight. The question of vital importance was simply whether with oil fuel or coal fuel the greater amount of steam could be obtained from the same boiler.

The experiments will be continued with burners of all types, and tests will be made having in view both efficiency per unit of fuel and per unit of surface or weight of boiler. From the data thus developed we may hope that a long step forward may be made in the practical development of means for utilizing our natural resources of oil as fuel both for naval and mercantile purposes.

From the strategic point of view, the importance to the United States of the development of means for the utilization of oil for naval purposes is of the highest importance. The United States has perhaps more to gain from the use of this type of fuel for warship purposes than any other nation. Our largest oil fields are within easy reach of the coast, and those of Ohio and Pennsylvania are already connected by pipe lines to several Atlantic seaports. The recent discovery of the Texas fields has given fresh impetus toward the wider use of oil as fuel, and among marine engineers there seems to be a general feeling that the possibilities of this type of fuel deserve the most serious consideration and study on their part.

THE growth in importance of the Navy, its maintenance and further development, is indicated by the grand total of the present Naval Appropriation Bill, which amounts to nearly $80,000,000. It is not so many years since the grand total covered by the Naval Appropriation Bill amounted to somewhere about $20,000,000. Naturally the larger part of the present appropriation is for the continuation of work on ships under present construction, together with such other sums as are needed for general maintenance of the service. The new ships proposed in the bill are six in number—two battleships of the heaviest and most powerful type, two armored cruisers, the most powerful of their type, and two gunboats.

A feature of the bill as presented by the House provided for the construction of one each of the above ships in Government navy yards. This provision met with the strong disapproval of the Government officials, and is omitted from the bill reported from the Senate. The proposition seems to be in entire disagreement with the policy of the Government for the past ten years, during which the equipment of the navy yards has been directed toward facilities for repair and maintenance rather than for original construction. It is true that in large measure the equipment required for the one is the same as for the other, but it is very sure that in the navy yards at present the equipment provided is far from being adequate for both. According to the opinion of the Chief Constructor over $500,000 would be necessary to equip the Portsmouth, New York, and Norfolk navy yards for battleship construction, while much larger expenditures would be necessary at Boston, where the present equipment is very small. The provision in the bill as reported from the Senate, that these ships shall not be constructed in navy yards unless it is found impossible to obtain satisfactory bids from private builders, will undoubtedly insure their construction in private yards.

Another feature of the bill, of far greater interest than the figures appropriated might suggest, is the item of $400,000 for an engineering laboratory building at the Naval Academy. We have already in these columns referred to the importance of the work which it is proposed to carry on in this laboratory, and the appropriation thus made will provide for the inauguration of the post-graduate engineering course at the Naval Academy, with its wide capacity for usefulness to the highest interests of the service at large.

ONE of the most notable features of the present trade situation from the engineering standpoint is the continuance of difficulty in obtaining structural material, especially for shipbuilding purposes. The companies represented in the Steel Trust will practically not consider an order for anything approaching early delivery. Their entire prospective output for the coming year is probably almost entirely spoken for. In special cases arrangements may be made for deliveries on certain things at periods approximating six months, but for anything in the nature of special stock, particularly in shapes and angles, it is likely that the consumer would be unable to make much better terms than delivery in one year. This has resulted, of course, in throwing an unusual amount of work into the small establishments not covered by the trust; and while earlier deliveries may in this way be obtained, in most cases such establishments are finding it difficult to keep up with the orders which are coming their way. It is hard to foresee how long such a condition can last. The present demand for such material seems to be enormously beyond the rate of production, but the very fact that producers are not inclined toward any large extension in their producing capacity is perhaps one of the best evidences that they consider the situation abnormal and temporary. It seems to be the purpose of the steel maker to carry the present business of the country without expansion of capacity, and in the meantime to keep his various customers as well satisfied as possible with such deliveries as he is able to make, lest added capacity in answer to present demand may soon become a useless investment. The practical result is simply that work must either be postponed until the material can be obtained, or it must be picked up in irregular and accidental ways, and, in the latter case, usually at an advance of from ten to twenty-five cents per 100 pounds. It is not too much to say that questions relating to the delivery of shipbuilding material are today giving the builders more trouble than almost any other question in connection with the present industrial condition. A readjustment between supply and demand is certainly required, and the present condition, from the very nature of the case, cannot be long-lived. The builder will certainly hail with delight the day when he can place an order on relatively short delivery, and with certainty that he will receive the material at the time specified and be able to finish the ship on time.

MISHAPS AND REPAIRS.

Stern Frame Broken by Sea.

The tug *Tatoosh,* while crossing out over the Columbia River bar on February 28, 1902, met with an accident which is best illustrated by the enclosed picture, taken while on Moran's dry-dock at Seattle, Wash. The cause of the accident is still in debate, the usual Board of Water Front Directors (found in every seaport) saying off-hand that she struck the bottom, though no one aboard the tug felt her touch, and I cannot conceive how she could strike hard enough to break a steel forging 4 inches by 10 1-2 inches and no one feel it aboard. I believe the damage was caused by a sea breaking under the counter in the following manner:

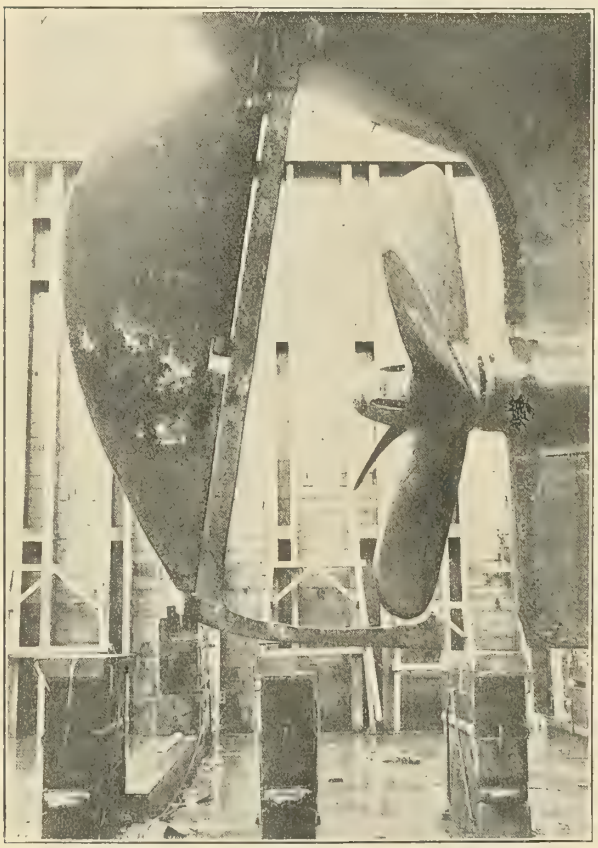


FIG. 1.—STERN FRAME BROKEN AT BOTTOM.

We were crossing out on a slow bell over a bar which had been impassable for three days previously, owing to a storm. The sea was at the time moderating, the tide running ebb, and wind and sea on the starboard bow. We proceeded nicely till on the outer edge of the bar, when, just as we were on the crest of a big swell, the wave broke, striking us with considerable force well aft on the starboard quarter, but none came aboard. At the time no attention was paid to it by any one of the crew, and we crossed out in safety. When outside in smooth water it was found that the boat would not answer a starboard helm, and investigation (above the deck) showed that the rudder stock was forced up through the deck about one inch from its normal position, and the tiller would only travel from amidships to one-half to port. Proceeding out into clear water, we stopped and could see a break and bend in the rudder just below the water line, the rudder post and shoe being visible and apparently all right. It was deemed unsafe to cross in again under these conditions, and the tug *Wallula* gave us a line in through the breakers, when we proceeded to Astoria under our own steam.

Tipping the *Tatoosh* with trimming tanks revealed the conditions shown in Fig. 2, and an examination by a diver informed us that the shoe had broken close to the stern post. We left Astoria March 11, the tug *Pioneer* giving us her hawser and preceding us up the coast until inside Cape Flattery; from there to Seattle we were unattended, and arrived safely on March 12, twenty-nine hours from Astoria.

The photograph, Fig. 1, shows the condition revealed when on the dry-dock, the break at the top showing less prominently than that below. The conclusion was that the damage was done by a breaking sea striking the rudder with the helm to port, the blow being greater than a steel beam, 4 inches by 10 1-2 inches and loaded

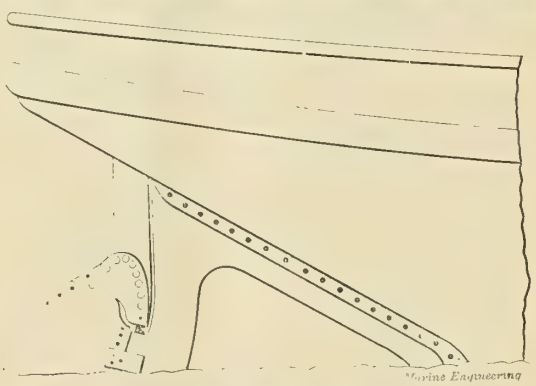


FIG. 2.—BEND IN STERN FRAME AT TOP.

at one end, could stand. The rudder was removed, taken to the shop, and the cover plates and rods and filling taken off. It was then found that the frame was cracked near the top in two places, as shown in the sketch, each crack extending nearly through the forging. Double patches were placed over the cracks and riveted on with through rivets, and in place of the original 1-4-inch plating 5-8-inch plates were fitted on.

Repairs to the stern frame were made, as in Fig. 3, by first heating the frame in the neighborhood of the crack by means of Well's lights in which coal oil was used for fuel, and also by heating the rudder post at the bottom fracture. The ends of the break were then drawn together with a chain tackle and the rudder post straightened. Rivets were drilled within the keel for a distance of 3 feet forward of the break and a shoe drilled for rivets 3 feet aft of the break. Templates were then taken and double-angle patches made of 1 1-4 inch mild steel, fitting over the plating and on the bottom of the bar keel, as shown in Fig. 4. After the patches had been fitted they were removed and puttied with a cement composed of litharge and glycerin, and then drawn up solid with through bolts and left until the cement hardened; then the bolts were removed, one at a time, and through rivets put in their places. The crack near the bottom of the rudder post was reinforced by a U-shaped patch put on in a similar manner.

Permanent repairs will be made in the fall and will consist of a new cast steel stern frame and a solid plate rudder, both of which will have to come from the East, as we cannot get steel castings on the Pacific coast.

These repairs were made by Moran Bros. Company at Seattle. In writing this article I intend to convey an idea of the force of the breaking sea.

F. H. NEWHALL.

Repairing a Copper Feed Pipe.

Editor of MARINE ENGINEERING:

DEAR SIR:—I have been very much interested in the accounts of accidents which have been published in your columns, and I thought that perhaps you might like to hear of a little experience which I had in my younger days. My first job in charge was on the *B*———, a small coasting steamer trading between Galveston and West Indian ports. The machinery consisted of a compound condensing engine of about 400 horse power with two single-furnace boilers. The machinery had been running about ten years with very little overhauling or repairs, so that in many ways it was in pretty bad shape. I was young and without much experience, but did the best I could, and we managed to get along pretty well in some sort of a way.

On the trip to which I refer we were bound for Campêche, and the first accident occurred as we were running across the Gulf the first night out. Signals of distress were sighted on deck, and, running down to them, we found an English steamer, about our own size, utterly helpless, with propeller shaft broken just inside the stern tube and propeller gone by the board. She had been in this condition since the early afternoon, and we promptly made arrangements for taking her in tow, as the captain, of course, scented a rich haul for salvage. We managed to make fast to her without very much trouble, as the sea was moderate, and, after about a couple of hours' delay, we proceeded on our way with the steamer in tow.

Things went fairly well until the next forenoon, when the water tender reported a split in the feed pipe under the floor plates, not far from the feed pump. I was on watch at the time and went immediately to examine the condition of affairs. I found a split about 8 inches long and open nearly a quarter of an inch at the widest part. The feed pump was working at the time, and it was clear to be seen that the water was all going into the bilge and none of it into the boiler. The water tender told me that everything had been working all right a few minutes before, and he had been feeding into the starboard boiler. He thought he had noticed some kind of click, followed by a groaning and laboring of the pump, and then a breaking away as though there had been sudden relief. From later examination it appeared that the boiler check must have suddenly become jammed in some way, and the extra load thus thrown on the pipe first slowed down the pump, and then, when it broke, eased the pressure and the pump started off again. There was no way of getting water into the boilers except from this pipe, and it was very sure that with such a leak in the pipe this would be utterly impossible. I therefore reported to the captain, and we shut down the engine and considered the best way to make the repairs. For our own sake, as well as for the tow which we had, it was absolutely necessary to try and patch things up in some way, so as to reach port as soon as possible and while reasonably fine weather lasted. The feed pipe was copper, and I remembered having seen two or three pieces of sheet copper in the store room. The first idea that came to my mind was to try to solder a strip of copper over the split and reinforce it with a wrapping of wire. I had to give this up, however, because I remembered that we had no soldering kit on board whatever. If we had had a little solder I might have made out in some kind of a

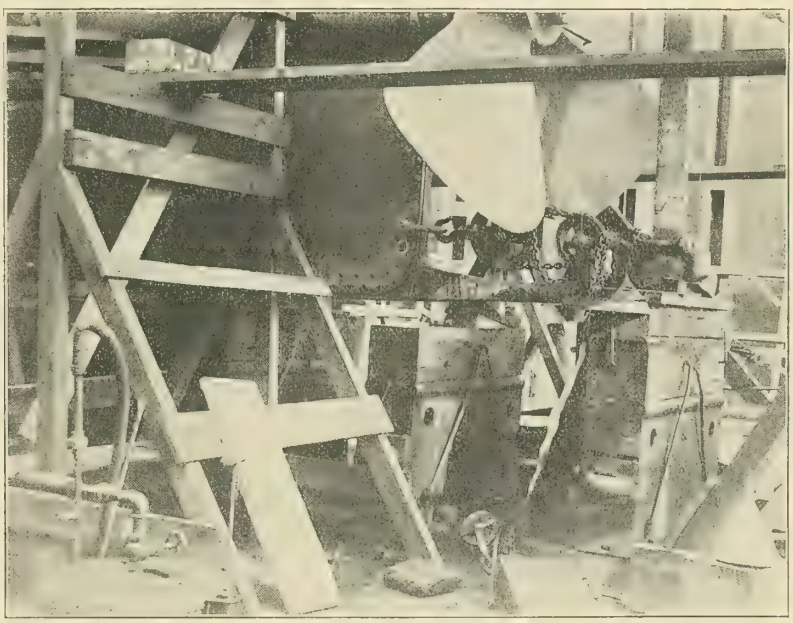


FIG. 3.—METHOD OF REPAIRING STERN FRAME.

way, but there was not a bit of anything of the kind. I didn't know as much then as I have learned since about the power of water to escape under pressure, and so I thought I would try first closing the edges of the split together and then putting on a heavy wrapping of canvas and marline with red-lead putty over the split. So we got together the necessary materials and, after closing the edges of the split down nicely together, put on the wrapping as planned.

In the meantime the fire in the starboard boiler was allowed to die down, the boiler was disconnected and steam was blown off, and the pressure run down so that we could examine the check valve. We found it jammed in the stem near the seat, thus allowing but very small lift and accounting for the extra load suddenly thrown on the feed pipe. This trouble was remedied without very much difficulty, and by the time the

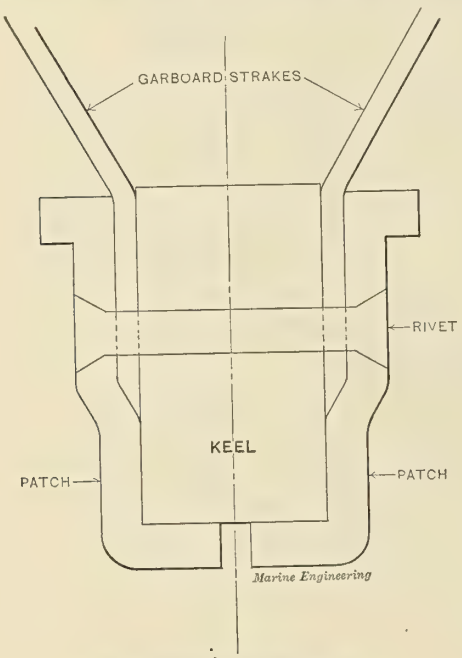


FIG. 4.—PATCHES ON THE KEEL.

wrapping was on the feed pipe the check was closed up again and in good order.

As soon as the pressure was put on the pipe, however, the trouble started in immediately; the marline stretched, the split opened out again, and the condition was nearly as bad as at first. All this might have been foreseen, but I did not sufficiently appreciate the condition I was dealing with. My next move was to substitute a strip of thin copper for the canvas and some light copper wire for the marline. The exchange was made and the new patch was adjusted in about an hour's time. The pressure was then put on the pipe again, and, to my great disappointment, with the same result as before. The copper bulged, the wire stretched, and the water leaked out in streams from all about the edges of the patch. I now began to realize that I was dealing with a situation where some vigorous measures were necessary, and I therefore decided to make a fresh start. The thin patch was accordingly taken off and a somewhat similar one, but made of sheet copper of about gauge No. 10, was formed, somewhat roughly, to fit the pipe, while in the meantime one of the firemen, who was a bit of a blacksmith, made three strap clamps of suitable size to be set up by bolts, of which we found a suitable size in stock. The edges of the split were again closed up, the heavier patch fitted in place and secured by the screw clamps. This time, when the pressure was put on the pipe, the results were very much better. The metal of the patch, aided by the clamps, held its place and the putty did fairly good work in closing up the space between the patch and the pipe. The patch had been rather roughly fitted, however, and there was still a considerable amount of leakage. I was satisfied now, however, that I could master the difficulty and make a good job of the repair, so I removed the patch again and had it more carefully fitted to the form of the pipe, at the same time having a couple of extra straps made. I also hunted up a piece of fine-mesh wire gauze, and cut out a strip the size of the patch as a carrier for the putty. This was then well charged with putty on both sides and placed between the patch and the pipe. The five clamps were then put in place and screwed up, bringing the outer patch, the wire netting, and the surface of the pipe all into close contact. This time, when the pressure was turned on, the result was found to be perfectly satisfactory. The wire gauze assisted in holding the putty in place, and the straps forced the surfaces into such close contact that hardly a perceptible leak could be found.

While we had been experimenting with these various forms of patch the pressure in the starboard boiler had been gradually allowed to rise, so that as soon as we were sure that the pipe would hold we put the necessary feed water into the boilers, and shortly after had the necessary head of steam to proceed on our way.

The feed pipe, thus repaired, gave no further trouble for the rest of the trip, and we succeeded in carrying our tow safely into port, greatly to the satisfaction of the owners of both boats and of all the parties concerned. I may further add that, due to a lack of time for repairs, the *B*——— made two or three trips with the feed pipe in the same condition and without any trouble whatever. Finally, in connection with a somewhat general overhauling and as a matter of precaution, the split portion was replaced by a new section of pipe.

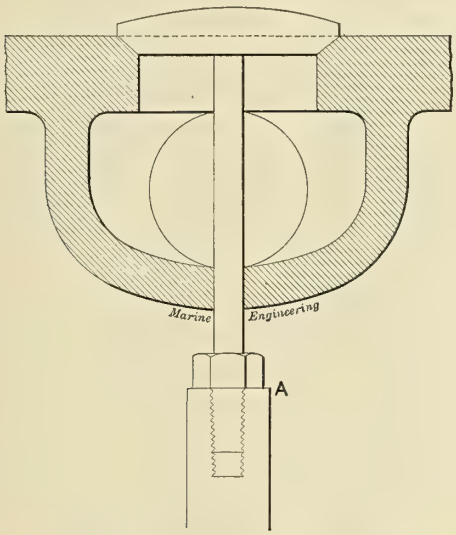
John Leavenworth.

Repairing Gas Engines.

Editor of Marine Engineering:

The readiness with which a gasoline engine can be started, the little skill required to operate it, its cleanliness and the attention it requires while running have made it the most favored of all motive powers for the propulsion of small craft, oyster boats, yacht tenders, etc. Very few yachtsmen would think of purchasing a steam engine and boiler for an auxiliary at the present date, as besides the time lost in preparing the engine for running there is the drawback of constant attendance, which will soon transform a pleasure trip into an unpleasant day's work. The necessity of securing a permit to operate a steam boiler on board of even the proverbial nutshell may also be considered a serious objection to steam power. A good many less ex-

perienced yachtsmen will advocate electricity as a motive power for small boats, but electric launches are confined only to a limited radius about a charging station which excludes them from long cruises. The storage battery also has a limited life, thus making the running expenses of an electric launch rather great. Thus it will be readily understood why the gasoline engine has gained so much favor. The cost of running a gasoline engine is but very small per horse power per hour, and after the engine is started, which does not require any preparation, it needs but little attention. It may also be said that the fuel for these engines can be obtained everywhere and taken aboard very quickly. These facts make this type of motor a universal power, which can be relied upon for a long cruise. But in spite of all the good points these engines have also their faults. The greatest of these faults is the sudden refusal to run, without any apparent reason. Such mishaps are commonly called by yachtsmen "breakdowns"; but as in the majority of such cases nothing serious



EXHAUST VALVE ON GASOLINE ENGINE.

has happened to the engine itself, this is hardly the proper word to use, and in most cases the fault can be remedied in a few minutes by the owner himself.

In one case I saw a man lose his temper to such an extent that he picked up the monkey wrench and struck the engine, which refused to start while he was trying to leave a dock. To my amusement the engine started after this without any further trouble, as soon as the assistant turned the wheel, remarking, "I'll make you go." Now this man did not know why the engine started after this vicious assault, while the fact was simply this: The exhaust valve was operated by a rod, by means of which the exhaust cam would raise it from its seat during the exhaust stroke. Into this rod the exhaust valve stem screwed and was held by a jam nut, as shown at *A* in the cut. This jam nut happened to be loose, and the valve and stem started to turn and unscrew. This probably was caused by vibration and the consumed gases passing through at a very high rate of speed. The valve stem thus lengthened did not allow the valve to seat properly; there was consequently no compression, and the explosions were too weak to run the engine without aid. While the owner was wildly turning the crank, I noticed that he would get a weak explosion only about every four or five revolutions, while the engine should, under normal conditions, have exploded every other revolution, being of the four-cycle type. This was due to the consumed gases being drawn through the partly open exhaust valve, and intermixing with the fresh gases to such an extent as to prevent an explosion.

Now, when this man struck the engine, he happened to land the wrench right on the exhaust rod, causing it to bend, and thus the rod shortened, allowing the exhaust valve to seat, and everything seemed all right. Now if this man would have used a little patience and common sense, he would not have spoiled his day's outing for himself and friends, and would also have saved the repair expense. For, three hours later, the party appeared again in tow of a good-natured oyster man, and landed at the dock belonging to the shop I had charge of and asked for the superintendent. Great was their surprise when the same man who a few hours before had offered to help them out simply as a favor, and whose offer they had rejected, now appeared as the superintendent, and after examining the battered engine politely told them that the shop expenses would amount to $15.00, which they were then willing to pay.

H. E. Raabe.

Points in Setting Up Gasoline Engines.

Some points covering the chief difficulties met with in setting up gasoline engines are mentioned in a communication to *American Machinist* as follows.

Where gasoline is to be used, it should be said at the start that the piping cannot be too carefully done, for gasoline is one of the meanest fluids to pump that there is. Use common soap in making the joints, as gasoline will cut white or red lead, asphaltum and most of the substances generally used for this purpose, and see that you have good threads. I prefer galvanized pipe, although ordinary iron pipe is generally used. Use ground brass unions and have one at the engine and at the tank in both the suction and overflow pipes. The suction pipe must be tight; if it is, and if the check valves are good, the plunger and barrel of the pump are of secondary importance. There should be a check valve at the tank. I put the union between the valve and tank, so that, if the pipe is disconnected when full of gasoline, it will not be wasted. In using gasoline, avoid too rich a mixture, as the combustion will be imperfect and carbon will be deposited on the sparking points. This of course will result in a poor spark, as the current is only sufficient to do the work with clean points. A stronger current is not desirable, as the points would not last. An engine will give more power on gasoline than on natural or artificial gas. Similarly, natural gas is better than artificial.

If a battery is used for ignition, keep it in a warm place, as many cells do not work well at ordinary low temperatures. Always throw the switch when the engine is not running, as otherwise if the engine happens to stop with the points in contact the battery will be on closed circuit and will not last long.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MCALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER XI.

The days were now passing rapidly. The weather was so hot that the Professor was not in the least anxious to gather any more practical information by going below in the engine and fire rooms, so he spent most of his time during the day lolling around on deck, reading or writing. Occasionally he would talk with groups of his fellow-passengers, and, as a rule, he would interest them greatly, as he was found to be well informed on almost any subject that would arise in the course of the conversation. One of the lady passengers, who had evidently seen at least forty winters, not to mention how many summers, upon hearing that the learned man was a bachelor, became particularly interested in him, and was one of his most attentive listeners whenever he would talk. No matter whom he was addressing, the sprightly spinster would in some way manage to draw her chair close up to where he was sitting. Her attentions became so marked that they furnished a continuous source of amusement to the other passengers. As it gradually dawned upon the Professor that he was the object of her adoration, and not caring particularly for such attentions, he became quite shy and managed to stow himself away in places somewhat inaccessible to his admirer. On several occasions he was inveigled into playing an innocent game of euchre, and one evening he was invited by several sportily inclined young men to take a hand in a game of poker. This he declined with thanks, for, as Barney declared, "He was not the aisy mark that he looked."

Para was to be the next calling place, and speculation was rife as to what time the ship would get there. The poker-playing contingent got up the usual pool as to the time the ship would anchor, and the Professor came up with his five dollars in short order, thus showing that he had some sporting proclivities for a game where he would have an equal chance with the others.

One evening when the ship was nearing her destination the sky in the northwest became clouded, and, as the barometer took a sudden fall, the officers began to make preparations for a blow. The day had been calm and sultry, and the atmosphere at six o'clock was almost stifling. A portentous feeling pervaded the ship, and the Professor, in common with the other passengers, felt as if something dreadful were about to happen. The heavy clouds now almost obscured the sky, and over the starboard quarter they seemed of almost inky blackness. All movable articles about the deck were secured, and the captain and first officers were going around and examining all fastenings and lashings to see that everything was secure. Brilliant flashes of lightning illumined the sky at intervals, to be shortly followed by the deep rumblings of distant thunder. The Professor seemed awe-stricken as he stood by the rail and scanned the approaching storm. A light puff of cool wind struck his face, and at the same moment some one shouted, "There she comes." About half a mile away a dense wall of vapor could be seen whirling toward them in the semi-darkness. So rapidly was it approaching that before the Professor could make up his mind to run for shelter the tropical squall, for such it was, had struck the ship with its full fury. The ship was thrown nearly on her beam ends by the force of the gale, and it was all the poor college man could do to crawl on his hands and knees to his state-room door. Before he could open the door the rain came, and in almost an instant he was drenched to the skin. So heavy was the torrent accompanying the blow that the Professor felt as if a regiment of men were dashing buckets of water over him. The screeching of the gale, the roar of the downpouring rain, the almost incessant and blinding flashes of lightning, together with the terrific thunder, spread terror to his heart. It is safe to say that he would have willingly given up a year's salary to be on *terra firma* at that time. For over an hour the gale continued with unabated fury, and the terror-stricken man hung on and hoped. It was rumored among the crew, after the gale was all over, that he had spent the whole time on his knees praying. However that may be, the storm finally blew over, leaving a cool breeze and a delightful atmosphere, which everybody enjoyed to their utmost. Luckily not even a rope yarn had parted, so the ship proceeded on her voyage none the worse for her encounter with the short-lived storm. The chief engineer informed his brother that such squalls were of frequent occurrence in those latitudes, which information was not relished very keenly by the Professor, who had not fully recovered his equanimity from the trying ordeal which he had just been through.

The ship finally entered the region "where rolls the mighty Amazon," and in due time came to anchor off Para in Brazil. Upon looking over the pool which had been formed, it was discovered that the Professor's guess as to the time of anchorage was within fifteen minutes of the actual moment that the anchor was let go. The money, amounting to fifty dollars, was handed over to him at once, and he was the subject of congratulations from all concerned. He was naturally quite elated at his success as a guesser, but he immediately turned over the money to his brother, the chief, and requested him to divide it up equally among the firemen and coal passers, saying, as he did so, that they were the men aboard that ship who most deserved it.

The anchor had not been down long before the Professor and a number of the other passengers went ashore to see the sights. They did not find Para so attractive as their last stopping place, however, and, with one or two exceptions, all had returned by dinner time that evening. The captain told the Professor that, as there was so much freight to unload, the ship would remain in port for at least two days. The chief engineer, therefore, decided to make some necessary adjustments in the various journals, as the engine was thumping quite noticeably the day or two before they arrived.

The following day the Professor was feeling a little more ambitious than he had at sea, and, thinking that the engine room must be a little cooler than when the ship was under way, he determined to spend a few hours below. As all the men, with the exception of the water tenders, had had all night in, he found them all turned-to either in the fire room or engine room. The high-pressure crank pin had already been stripped, and the

first assistant, with the help of old Barney, was busy scraping away at the brasses. The white metal was in fairly good shape, but the pin was bearing a little too much on the sides of the brasses. This was being eased off, and, after trying the brass on the pin two or three times and scraping down the high spots, it was, in the opinion of the officer, fit to put back in place. The Professor was an interested observer of the various operations of scraping, putting in leads, setting up on the bolts, etc. When the brasses were slacked back and the leads removed, he noticed that the first assistant used an ordinary wire gauge to try the thickness of the leads at different points. The Professor suggested that it would be more reliable if he would use a micrometer caliper for that purpose, stating that the leads were so soft that they could be squeezed into notches below their actual thickness. To an inquiry as to what became of the leads after they were taken, the first assistant replied that he usually put them away in the engine room desk. The Professor then suggested that it would be a good idea to make a sort of scrap book out of brown wrapping paper and have a separate page for each journal. Then, by cutting three slits in the leaf for the pin or bearing in question, the lead could be slipped in place, and the position of the lead and the date it was taken could be written under it. He also suggested that the different thicknesses, expressed in thousandths of an inch from micrometer readings, could be marked opposite the points measured. By this method, he said, you can keep a continuous record of the adjustments on each bearing, and know at a glance just at what time the last adjustment was made and to what thickness the bearing had been set. The first assistant replied that he considered the college man's suggestion a good scheme and that he would get up such a book at once. After the high-pressure pin had apparently been properly adjusted, he noticed old Barney take a pinch bar, and, getting a nip between the side of the brass and the crank web, he gave it a sudden jerk, whereat the brasses gave a chug up against the after crank web.

"Now I know she's all right," said Barney. "I don't take much stock in them Mike Romets, or whatever it is you call 'em, but when you can move her with a bar without busting a suspender, she's all right."

The Professor was quite amused at Barney's philosophy, and concluded that for practical methods the old Irishman evidently knew his business. After they had finished with the high-pressure pin, they commenced preparations to raise the cap on the forward main bearing. While this was going on the Professor walked over toward the feed tank, where he saw a man removing a lot of dirty, greasy excelsior. In answer to a question, the chief, who happened to come around at that time, replied that the excelsior had not been removed since they left New York. To this the Professor remarked that, so far as filtering was concerned, the tank had not been of any service after the first three days out. The chief replied that he supposed that it had not, but informed his brother that the filtering material was so arranged that it was difficult to renew it while the air pump was in operation. The Professor suggested that it would be well to put it in bags or other compact form so that it could be pulled out easily. Continuing, he said that unless the discharge water was kept as cold as possible this form of filter tank was of comparatively little use, as the particles of oil in the water will not congeal and settle on the filtering material if the water is kept at a temperature much over 80 or 90 degrees.

"Of course," said he, "as you have no feed-water heater here, you naturally try to keep the hot well at as high a temperature as possible, consistent with a good vacuum. That is only an additional reason why a feed-water heater should be fitted on every vessel." Continuing, he said that he did not know of any very efficient filter on the market at the present time.

"I have had an idea for a long time," said he, "that eventually some one will devise a filter wherein the particles of oil will be removed from the feed water by centrifugal action similar to the manner in which they separate cream from milk in large creameries or cheese factories. This separation of the oil from feed water is one of the most important problems before the marine engineer to-day, and especially so since the water-tube boiler is so rapidly coming into use."

The chief agreed with him that this was a very important subject, and he said that he hoped some efficient device would be gotten up for the purpose.

"There is one little detail I want to call your attention to about feed tanks," said he, "and that is, if you ever have anything to do with getting one up, don't put one of those fancy float valves over the suction to the feed pump. I had one in here and ripped the thing out the very first trip I made with it. They work all right on paper, but they are bound to hang up or get out of order just when you least expect it. It's all rot to think that you are going to pump air into the boilers if you don't have such a valve. If I had a water tender, and he couldn't tell in an instant by the action of the pump that the tank was nearly empty, I'd fire him on the dock quicker than a snowball will melt in the lower regions. Then, too, I've seen a float rigged up so as to throttle down the pump when the tank gets empty. That's another crazy scheme; it may work all right on some tugboat around a harbor, but no such contrivance for me on board a seagoing vessel. If some of these youngsters who work in a draughting room and spend a lot of their time inventing such contraptions could go to sea and try to run them they would not be so anxious to get up such labor-saving (?) devices."

The Professor replied, quite warmly, that seagoing engineers were indebted to just such young fellows as he described for many of the greatest improvements they had around marine machinery. The chief said, bluntly, that he didn't believe it, and the Professor, not caring to continue the argument, let the matter drop, but clung to his own opinion. The chief, however, continued his growling and said:

"Now if some of your smart alecks want to get up something useful, let them invent a rig that will warn the water tender when the feed tank is nearly full, so that the water will not be wasted by running over into the bilge." The Professor replied that that was a very easy proposition.

"Why," he said, "just rig up a float so that when it rises to the top of the tank it will make an electrical connection and ring a bell in the fire room."

"There you go with your old float again," growled the chief.

As he was evidently down on floats, the Professor concluded to stop suggesting anything in that line. They walked around the engine room together, occasionally getting into an argument, and sometimes agreeing. At one stage of the conversation the Professor asked his brother why he did not have some system of painting the various parts of the machinery.

"If you want to know of a good system I will describe one for you," said the Professor. "Well," replied the brother, "your painting system may be all right, but I'm more interested in getting something to eat just at present, so let's go up to lunch and we'll talk about that afterward."

The two brothers then walked out of the engine room, and Barney, who observed the difference in their physiques and had overheard some of their arguments, remarked to one of the other oilers that "thim fellers will never get a job in a circus as Siamese twins."

QUERIES AND ANSWERS.

Q.—How are dimensions of commutators determined? Large generators have larger commutators than small ones, but I have not been able to find out whether the increase in size is made simply to make it in keeping with the increased size of the other parts, or whether it is actually necessary to make the commutator larger. If it is necessary to make the commutator larger, why is it, and how are the diameter and the face calculated? V. K. S.

A.—In large machines the commutator is made larger than in small ones because it is necessary, and not simply for the purpose of making a harmonious design. The number of commutator segments is determined by the voltage of the current, and by the number of poles. If the number of segments is reduced below a certain point, the sparking is liable to be severe. On general principles, the greater the number of segments the less the sparking, but by skilful designing the sparking can be greatly reduced for any given number of segments. As an average rule the number of segments can be estimated as equal to the voltage divided by ten and multiplied by the number of poles. This rule is used to determine the smallest number of segments permissible; thus, if the voltage is 100 and the machine has six poles, the number of segments in the commutator would be 60, or as many more as other conditions would permit. The diameter of the commutator is determined by the number of segments, and by the size of the armature wire, each segment having to be wide enough to be drilled or grooved at one end to receive the armature wires. The face of the commutator is determined by the strength of current, which latter determines the area of brush that must be in contact with the commutator to transmit the current without overheating. For carbon brushes the brush area is calculated at about one square inch for every 40 amperes of current, so that if the segments are one-third of an inch wide, the brushes will have to be three inches long if the current is 40 amperes, and this would make the face of the commutator about three and one-half inches.

Q.—We have a twin screw tug with compound engines, 15 inches and 30 inches by 22-inch stroke, carrying 125 lbs. steam; steam is supplied by two Scotch type boilers 11 feet 6 inches by 129 inches diameter, with two furnaces each 44 inches diameter by 8 feet 7 inches long. Each boiler has 153 tubes 3½ inches in diameter, and the grate bars are 88 inches long. The tops of the bars are 22 inches from the top of the furnace at both ends, and we have 13½ inches over our bridge wall.

Would these boilers make more steam or be more economical with shorter bars and the back ends lowered or not? Can you suggest anything that would be an improvement in her steaming or economy? E. R.

A.—From the data which you give it appears that you have about 54 square feet of grate surface and 1,415 square feet of heating surface in each boiler. This gives you a ratio of about 26 to 1. This ratio is low and you cannot expect an efficient performance of the boiler with anything approaching a fair rate of combustion per square foot of grate surface. It would undoubtedly be better to shorten your bars to about 5 feet 9 inches in length, thus giving you 42 square feet of grate surface and a ratio of heating to grate of 33.7. A grate 88 inches long is altogether too long for efficient work, and it is very sure that the back part of the grate is of relatively small value. You will probably be able to better burn your coal on the shorter grate than on the longer.

Regarding the height of the grates the data which you give indicate an area of about 2.7 square feet over the bridge wall for each furnace. This is rather small, and it is likely that the boiler would operate more efficiently with a somewhat increased size of passage at this point. It would probably be advantageous to lower the grate bars at the back end by about 3 inches, thus giving a height of 16½ inches over the bridge wall and increasing the area to about 3.6 square feet. Without more definite data regarding the actual performance of the boiler it would be difficult to recommend any other changes. From the proportions given, however, it seems likely that those above recommended would increase the economy of boiler under the conditions prevailing in ordinary practice.

Q.—Supposing you have a dynamo that gives 100 volts, how can you determine the amount of the current that will flow through any wire or lamp or motor? If you connect an incandescent lamp to the two wires running from the binding posts of the machine, and then connect a motor by the side of the lamp, the motor will take a great deal more current than the lamp. Now what makes one take more current than the other, and if there is a way of finding out what each one will take before connecting it to the machine, how do you do it? J. T. C.

A.—The flow of current in electric circuits is governed by Ohm's law, which is the A B C of electrical science. According to this law, the strength of the current flowing in any circuit is equal to the voltage divided by the resistance. The resistance is measured in ohms, the current strength in amperes, and the voltage in volts. Suppose the voltage is 80, then if a lamp having a resistance of 100 ohms is connected with the two wires, the current passing through it will be equal to 80 volts divided by 100 ohms resistance, and this is 8-10 of one ampere. Now, suppose we have a motor through which the current is 40 amperes, then the resistance offered by this motor to the flow of current through it is equal to 80 volts divided by 40 amperes, which is two ohms. In the case of a motor, the current that passes through the shunt coils wound upon the field is directly proportional to the voltage divided by the resistance, but with respect to the armature current the strength is not determined so readily. The motor armature, when in motion, develops a counter pressure, which, like the direct voltage, is measured in volts, so that to determine the true pressure acting to force current through the armature, we must deduct the counter from the direct voltage. Thus, in the case cited above, suppose the counter pressure of the motor is 75 volts, then this deducted from the 80 volts of direct pressure leaves a net pressure of 5 volts. Of the 40 amperes that pass through the motor, suppose that 2 pass through the field coils, and 38 through the armature, then as the net pressure acting in the armature circuit is 5 volts, the resistance of the armature is equal to 5 divided by 38, or nearly 132-1000 of an ohm. As the current through the field coils is 2 amperes, and it is forced through by the full 80 volts, the field coil resistance must be 80 volts divided by 2 amperes, which is equal to 40 ohms. By the same process the strength of current that flows through any circuit can be determined.

Q.—Please give me the United States Government rule how to find the distance from the fulcrum a given weight is required to be placed to allow the valve to rise at a given pressure to a lever safety valve.

A.—The Government gives no rule for the solution of this problem. It is a problem which must be solved by the principles of mechanics. The following rule is based on these principles, and will enable you to solve such problems.

Multiply together the pressure per square inch, the area of the valve in square inches and the distance from the center of the valve spindle to the center of the fulcrum. From this subtract the product of the weight of the valve and spindle by the distance from the center of the spindle to the center of the fulcrum, and also the product of the weight of the lever by the distance from its center of gravity to the fulcrum. Having subtracted these two quantities from the original product, divide the remainder by the given weight. The quotient will be the distance of the weight from the fulcrum.

Q.—What is the distinction between a gas and a vapor and to which does steam belong? What is supersaturated steam? J. C. B.

A.—We suppose that you understand the three states in which matter may exist—solid, liquid and gaseous. To fix our ideas, however, we may remember that matter is considered to be composed of very small particles called molecules, all of which are supposed to be in a state of more or less violent agitation or motion. If the motion of each molecule is about a fixed center, or if it is supposed to remain in a fixed part of the body, then the body in such condition will retain its shape and is what is usually known as a solid. If the molecules are, however, free to move about one with reference to another so that the body readily changes form, it is said to be a liquid or in the liquid state. If the motion of the molecule is in straight lines hither and thither, bound to no fixed locality and always striving to get as far apart as possible, the body can be said to have no shape or form, as it is always trying to expand to a larger and larger volume. In such case the substance is said to be a gas or in the gaseous state.

You also remember that a change of state from solid to liquid or liquid to gaseous is usually brought about by the addition of heat accompanied by a change of volume. Now when a substance first changes from the liquid to the gaseous state in general, or, in other words, while the pressure, volume and temperature are very near the values which correspond to such a change, the substance is usually called a *vapor* or is said to be in the vaporous condition. A substance in the so-called gaseous condition is understood to be at a point regarding pressure, volume and temperature, far removed from the locality corresponding to the change of state from a liquid. There is no sharp line between a vapor and a gas. The former simply means a substance in the general gaseous state, but very near, as regards pressure, temperature and volume, the condition of change from a liquid; while a gas means a substance in the general gaseous condition and very far removed from the pressure, temperature and volume corresponding to the change from a liquid.

Steam as ordinarily used is a vapor simply because its volume, pressure and temperature are very close to that corresponding to a change of state from water. In fact steam in the ordinary state is actually at the point of change, and any decrease in temperature or increase of pressure would result in a certain amount of steam passing back into the liquid condition.

Steam in this condition is said to be *saturated*. If, however, saturated steam is heated out of contact with water so that its temperature and pressure for the same volume become higher than the values for saturated steam, it is said to be *superheated*. In general, superheated steam may be defined as steam having a pressure and temperature for a given volume higher than the values belonging to saturated steam. From the preceding definitions it is clear that as we begin to heat saturated steam in this way we begin to carry it toward the gaseous condition. So long as it is slightly superheated we may still call it a vapor; but highly superheated steam, being carried far away from the saturated condition, is more properly called a gas.

The word saturated may be somewhat misleading, having in view its ordinary meaning. Saturated steam contains no water whatever. It is simply pure steam, just as it is formed from the water and ready to change back with any increase of pressure or decrease of temperature as noted above. On the other hand, *supersaturated* steam implies simply a mixture of saturated steam and water. It may be remarked that superheated steam and water will not remain together in equilibrium. The steam will give up part of its heat and come down to the saturated condition, while a small additional quantity of water will be vaporized. Saturated steam and water may, however, be mixed and remain in equilibrium, and such steam containing in suspension a certain amount of water is said to be supersaturated.

Summer Meeting.—The summer meeting of the Schiffbautechnische Gesellschaft was held from June 2 to 5, 1902, at Düsseldorf, Germany. The most interesting programme was carried out, including papers read on topics of interest to shipbuilders, and excursions to various sections of shipbuilding and manufacturing industry. Members of the Society of Naval Architects and Marine Engineers were invited to attend.

ENGINEERS' DICTIONARY.—XXXVII.

Racing. The pitching and 'scending of a ship in a seaway cause wide variations in the immersion of the propeller. At one instant it may be almost entirely out of the water and the next deeply immersed. With constant steam pressure this will lead to an extremely violent and irregular motion of the engine, known as *racing*. Various forms of marine governors have been proposed and are in use, to some extent, for the purpose of controlling this condition. See further under **Governor.**

Radial—Float, Wheel, Paddle Wheel. See under **Paddle Wheel.**

Receiver. In a multiple-expansion engine the space between the valves of two successive cylinders is known as *receiver* space. In some cases a special chamber or receiver is thus provided, into which the steam in one cylinder is exhausted before it enters the next following. In most cases with modern marine engines having three or four cranks, however, no such special volume is required, and the receiver space consists simply of the exhaust passages and piping between the valve of one cylinder and that of the next following.

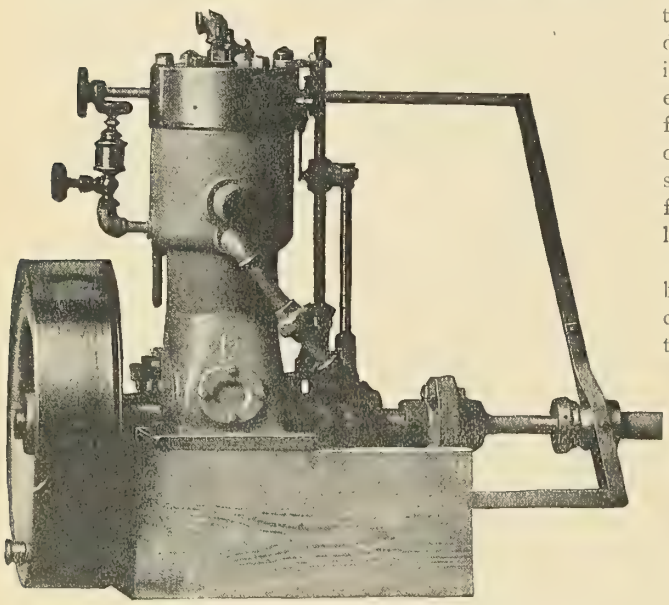
Relief Cock—Valve. A cock or valve fitted to a steam engine cylinder, and intended to relieve the cylinder of water which may enter with the steam. There are two varieties of such relief valves, those which are operated by a lever under control of the engineer, and those which operate automatically under a certain excess of pressure. The latter consist, in effect, of a special type of spring-controlled safety valve and operate in the same general way. When an engine is first started up under steam, or in case the boilers should foam or prime, considerable quantities of water may find their way into the cylinder. If there were no means of removing such water there would be danger of breakage or serious damage to some of the parts. It is for the purpose of removing the water and guarding against the danger of such damage that relief valves are fitted.

Resistance. For the marine engineer this term has chief reference to the resistance which opposes the motion of a ship through the water. It is the business of the screw propeller or paddle wheel to develop a forward thrust which shall overcome this resistance and thus insure the movement of the ship as desired. The resistance of a ship is usually referred to under two heads: the *skin resistance* and the *residual resistance.*

The skin or frictional resistance is that part of the total resistance which is supposed to be due to the mutual action between the skin of the ship and the surrounding water. Due to this mutual action, the water in the immediate vicinity of the surface is thrown into confused eddies and whirls composing a kind of surrounding blanket of water. Work is required to generate and maintain this blanket of eddying and whirling water, and the resistance which it occasions is therefore known as the *skin* resistance, and sometimes, from its analogy to the surface effect between solid bodies, as the *frictional* resistance. In addition to the skin effect, consisting of the surrounding blanket of eddying water referred to above, the movement of a ship through the water produces a series of other effects, chiefly represented by waves and distributed surface disturbances reaching to a considerable distance from the ship. To

generate and maintain such a system of waves and like disturbances work is also required, and the resistance which this occasions is known as the residual or wave-making resistance.

In this view of resistance the two kinds are classified in accordance with the character of the disturbances which are produced in the water. A different and perhaps juster view of resistance may be obtained by considering it as due to a disturbance of the surface pressures acting between the water and the ship. When the ship is at rest these pressures or forces all act perpendicular to the surface. When there is relative motion the total force acting between the ship and water is no longer perpendicular to the surface. It will have, therefore, a perpendicular component or part, and also a component or part lying along the surface.



TWO-CYCLE MARINE GASOLINE ENGINE.

The total action, therefore, may be viewed as the result of these two forces acting between the water and the surface of the ship, one of which acts perpendicular to the surface and the other along the surface. The former may be considered as the cause of the waves and distributed surface disturbance, while the latter is the cause of the skin effect. This view, therefore, serves to connect the two methods of considering the resistance as a whole. The actual resistance of a body to movement through a liquid is very imperfectly understood. It seems to depend upon so many obscure conditions, and the influences of these seem to be related in such intricate ways, and our knowledge of the internal constitution of a liquid is so imperfect, that up to the present time there is no satisfactory theory capable of dealing with this problem, and in consequence reliance is chiefly placed upon the results of experience and of direct experimental research upon small models.

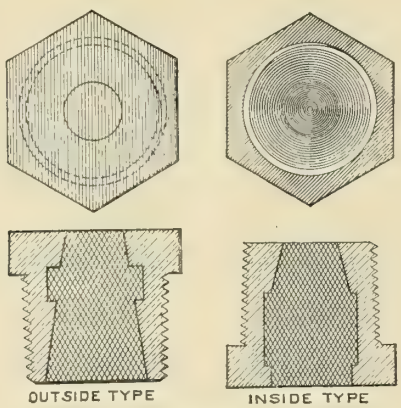
Rules for Launches.—The Treasury Department has decided that naphtha and gasoline launches shall come under the class of steam launches in regard to the signal lights which are to be carried.

ENGINEERING SPECIALTIES.

Two-Cycle Marine Gasoline Engines.

There are many difficulties to be found in the two-cycle type of gasoline engines which have in the past condemned it for general use. Among the essentials of a good engine of this class are: First. It must have a good generating valve that will give a correct mixture. Second. The crank case must be tight and of the least cubical capacity, with shaft bearings packed to avoid leakage, so that from 4 to 6 pounds crank-case pressure may be obtained at each stroke. Third. The piston must be properly fitted and packed so that it will not drag heavily, due to heating, but will give a compression on the up stroke. Fourth. There must be a proper sized direct passage to transfer the mixture from the crank case to the cylinders, and there must be a well-designed baffle plate fitted close to the walls of the cylinder. Fifth. The cylinder head must be properly jacketed and properly shaped on the under side so as to form a return bend for the incoming mixture to thoroughly drive out the burnt gases of the preceding stroke, and free from square corners or pocket the different gases. Sixth. The igniter must be simple, reliable, and durable, whatever type is used.

These points are all claimed for the gasoline engine built by John F. Kemp, Quincy, Mass. Forged steel crank shaft and bronze bearings are used, and the materials and workmanship throughout are of the best.



TWO NEW TYPES OF FUSIBLE PLUGS.

Fusible Plugs.

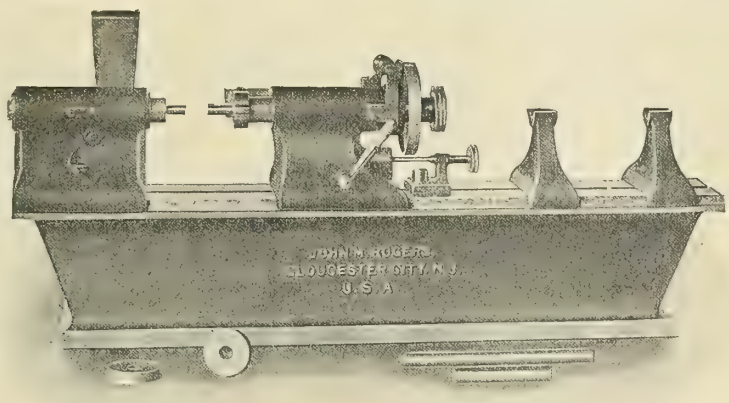
The recent action of the United States Treasury Department in enforcing the provisions of Section 4436 of the United States Revised Statutes, regarding the specifications as to the manufacture of fusible plugs, has attracted considerable attention to this boiler fitting. Fusible plugs have been used in boilers for a great many years, and the Government, recognizing the important function of this accessory, requires that all plugs used on boilers of steam vessels should be made of bronze and have no other filling but pure Banca tin.

Many plugs have been offered on the market which are filled with fusible alloys composed of other metals. which, although melting at very near the same point as Banca tin, are not absolutely reliable. Since the disaster at Philadelphia last fall, the United States Steamboat

Inspection Service of the Treasury Department has taken cognizance of the fact that inferior plugs were offered upon the market, and issued a circular requiring that all fusible plugs should be filled with pure Banca tin and stamped with the manufacturer's name, and that an affidavit setting forth this fact should be filed with the inspector having charge of the boiler inspection at whatever point the plugs were used.

The Lunkenheimer Company has manufactured fusible plugs for a number of years, all of which comply with these specifications, and, having made affidavit before the United States Steamboat Inspection Service, to the effect that these plugs comply with these requirements, the same are accepted by all inspectors throughout the United States. Herewith are illustrated two forms of plug, namely, the outside and inside patterns, same to be screwed in either from the inside of the boiler or from the outside through the fire box or shell.

These plugs are manufactured by the Lunkenheimer Company, of Cincinnati, Ohio, who will be pleased to give further particulars upon application.



STANDARD MEASURING MACHINE.

A New Measuring Machine.

A new standard measuring machine has been recently developed by the John M. Rogers Boat, Gauge and Drill Works, of Gloucester City, N. J. On this machine a system of multiplying levers is used for gauging the pressure on the test piece, being measured so as to eliminate the personal factor. An indicator is placed at the left hand end shown in the vertical case, and is made up of a series of levers, one of which is connected to the spindle in the head of the machine. By the use of these levers, the slightest motion of this spindle is multiplied many times and communicated by lever seen through the top end of the case.

In order to set the dial of the machine at zero, which operation must be carried out before any work is measured, the measuring points are brought into contact, the movable head is clamped in position and the measuring screw is turned, thus giving movement to the system of levers. This is continued until the graduation mark on the end of the lever coincides with the mark on the case. The index pointer of the graduated dial on the movable head is then set to zero. The spindle on the index head can then be run back and the operation be repeated an indefinite number of times and by different operators, and the two indexes will come to zero simultaneously. The movement of the upper end of the lever is so great in proportion to the movement of the spindle that the machine is extremely easy to operate and at the same time very sensitive. The machines are built in two sizes, viz., 0 to 12 inches and 0 to 24 inches, and they are also furnished to measure in the metric system.

A New Windlass.

The schooner *Perry Sutzer,* building at Bridgeport, Conn., is to be equipped with a new style of yielding, non-breakable windlass, which is specially valuable in the equipment of sailing vessels. One of the great disadvantages on board a large schooner with the ordinary form of windlass is that if the vessel is caught in rough weather, so that she must anchor in an exposed place, there is always the danger that the chain will part or the windlass break.

The captains of vessels have, for this reason, hesitated to anchor, and so have preferred to lie-to and ride out the gale or storm. But this is a dangerous proceeding, for when these large schooners are under short sail, as is necessary in very heavy weather, it is impossible to keep them head to the wind; in fact, they "fall off broad," and much of the time are actually lying in the trough of the sea, which every sailor knows is the most dangerous position to put any sailing vessel in.

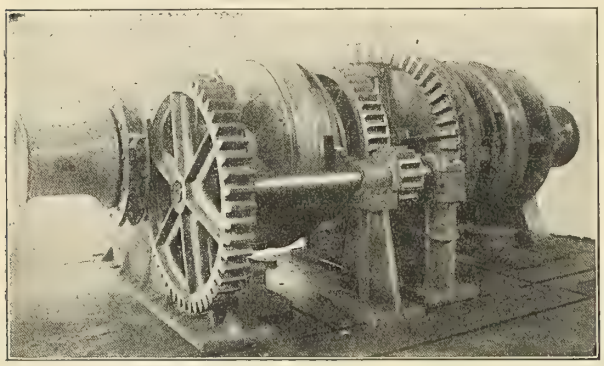
The danger of anchoring is eliminated on vessels equipped with these yielding, non-breakable windlasses, which will securely hold the chain, and yet allow it a certain run when excessive strain is brought to bear. The windlass shaft is mounted on three bitts, and carries two wildcats, two friction brakes and spring heads, two positive driving heads, two gypsy ends, and one starboard bevel gear and one bevel gear spring head. Each wildcat is provided with suitable pockets on the inner flange for the reception of springs.

Each friction brake and spring head has a positive locking device, worked by raised cams on the periphery of a locking ring and slotted block keys, and operated by means of a lever. The block keys are in full sight of the man operating the windlass, and the entire operation of locking or unlocking the windlass is accomplished by one motion of one lever through an angle not

exceeding 60 degrees. The wildcat is controlled by a friction band brake on the friction brake and spring head, and operated by a cam and lever arrangement. Each wildcat can also be locked fast to the friction brake and spring head by means of block keys.

The capstan is driven from the windlass shaft by means of bevel gears. The pinion gear is loose on the upright shaft, and is driven by means of a suitable clutch, so that the capstan can be worked without turning the windlass.

The bevel gear for driving the capstan is provided with suitable pockets for the reception of springs, and the bevel gear spring head is also provided with such pockets placed opposite to those in the bevel gear. There



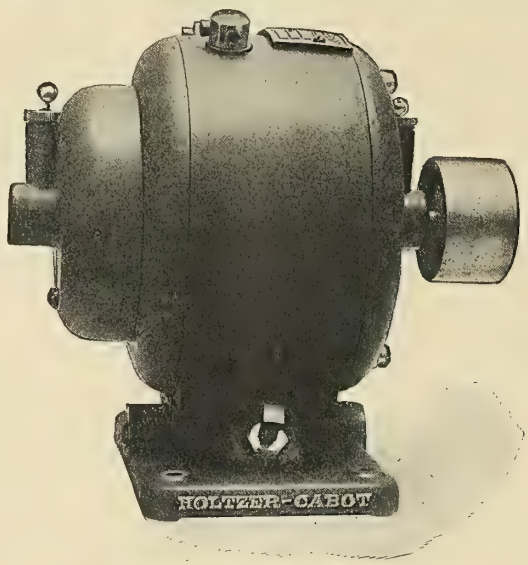
A NEW TYPE OF HAND WINDLASS.

is a suitable amount of space left between the lugs in which these pockets are formed, so as to allow these springs to compress when the strain on the chain is such that it has compressed the springs in the wildcat. In the opposite end of these spring lugs is also placed a suitable rubber spring to take the rebound which occurs where the strain is suddenly relieved. The bevel gear can also be locked fast to the head by means of block keys. The bevel gear spring head also carries the ratchet which holds the windlass from turning backward, and therefore the total strain on the chain is divided between the springs in the wildcat and the springs in the bevel gear.

This windlass is built by the American Ship Windlass Company, of Providence, R. I.

Gas Engine Igniter.

The Holtzer-Cabot Electric Company, Boston, Mass., has recently designed and placed on the market a new gas engine igniter of the dynamo type, which presents some novel and distinctive features, the most important of which are found in the fact that it does not require the use of a spark coil and is quite independent of speed, the latter feature overcoming the great objection to the dynamo type of igniter. There have been of late great advances made in the size of gas and gasoline engines, while the best practice seems to incline toward the multiple cylinder. These engines, by reason of the nature and volume of the body of gas to be ignited, the high frequency of the spark and also on account of peculiarities in the construction of the make-and-break device, require a large and practically continuous flow of current to produce satisfactory ignition. It is well known that the strength of magnetization obtainable in the best permanent magnets is for a given weight relatively quite small in comparison with that which may be secured with an electro-magnet. It is evident then, that a machine of the permanent magnet type, constructed to deliver any considerable amount of energy, would be unnecessarily large and heavy. This igniter has been, therefore, made of the dynamo type for the reasons given. It weighs 19 pounds, and will, if necessary, deliver continuously a maximum output of 50 watts. As stated the dynamo is practically independent of speed, and at 1,000 R. P. M. will deliver ample current for satisfactory ignition, while the speed may be increased to 2,500 R. P. M. without danger from burning out. Thus the igniter may be driven from the flywheel of the engine with the ordinary belt or friction pulley. The field core is of a solid casting of soft steel, and the armature is of the drum type carefully laminated and wound with double silk-covered magnet wire. The shaft is of high-grade steel and the bearing sleeves are of phosphor bronze. The brush holders and commutator are large and heavy, while the brushes are of a special composite structure, combining the substantial qualities of carbon with the higher conductivity of



DYNAMO TYPE GAS ENGINE IGNITER.

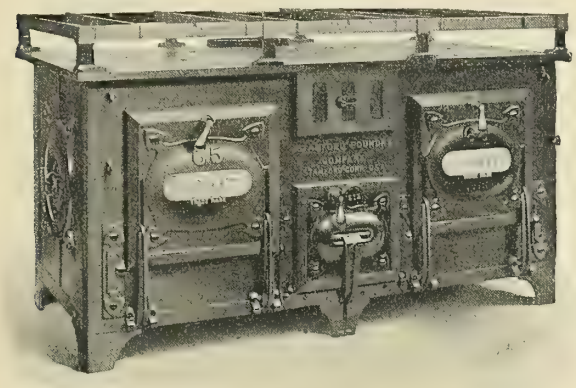
copper. The machine is rendered quite impervious to dust and moisture by a protecting shield, which fits over the commutator and brushes. This may be easily removed, making the brushes and commutator readily accessible. The body of the machine is mounted on a light-hinged base in such a manner that a wide range of adjustment may be effected without using sliding contacts or clamping nuts.

Galley Range for Steam Ships.

There is one thing that the captains and stewards of the sailing vessels of our merchant marine are familiar with, and that is the Shipmate range in the galley, for this range is probably in use on more of our sailing vessels than any other range, or perhaps than any other two or three ranges combined. Many steam vessels, as well, use the Shipmate; but heretofore large steam

vessels have been prevented from using it because the largest size of the range was too small for their requirements. To overcome this difficulty the number 65 Shipmate has been made.

This is a five-foot, two-oven range suitable for cooking for from 65 to 75 persons, according to the requirements. The matter of durability has received careful consideration in its construction, and the range is made very heavy, to stand the hardest kind of use. The top is composed of removable plates, the section immediately over the fire having two rings and a small cover. By an invention patented by the makers of these ranges the grate-frame is dispensed with, and the bricks lining the fire-box are independently supported and have their lower edges protected by heavy guard strips, which are not disturbed when the grate is removed or changed. The guard strips are taken out or put in without disturbing the bricks or even loosening a bolt. Each down flue has an independent damper, by means of which the amount of heat going to each oven can be closely regulated, and nearly all of the heat can be thrown to either oven if desired.



A SHIP RANGE.

The doors all drop and are supported horizontally, when open, by strong braces, which will sustain several hundred pounds. The ashpit door can be opened sufficiently for draft without extending into the room, or can be let down to a horizontal position when ashes are to be removed, forming a hearth preventing littering the deck. The Stamford Foundry Company, Stamford, Conn., will be pleased to send, free, a catalogue giving full description of this and the other sizes of Shipmate ranges, together with a list of their numerous Shipmate agencies.

The Simplex Water-Tight Electric Fixture.

A novel water-tight electric light fixture has recently been placed on the market by R. E. Kirk, Jr., Company, of 210 Patterson street, Baltimore, Md. The most striking feature of this fixture is the elimination of the objectionable outer glass globe (commonly used on other types of marine fixtures), by a self-adjusting water-tight joint made directly on the lamp or attachment inserted in the fixture. By this means the lamp is held gently but firmly in its proper position, making it impossible to jar or shake out. This also "cushions" the lamp against unusual shocks, reducing breakages to a minimum. Part of the weight saved by the elimination of the outer glass globe is put into the construction of the shell and guard, both of which are capable of withstanding the roughest handling. The guard is cast, which is another departure from the conventional method of making this important protection to electric lamps. By casting the guard the use of soft wrought brass and numerous rivets is done away with, besides making it stronger and more serviceable. This fixture

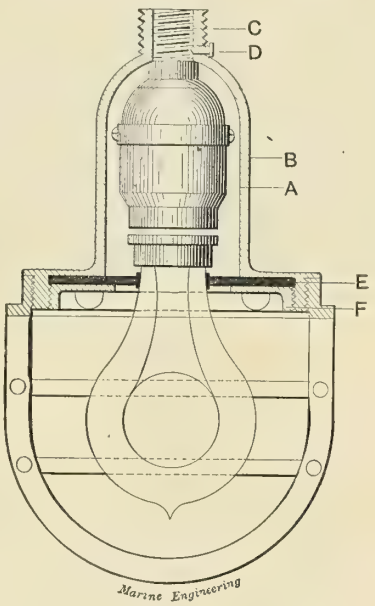


FIG. 1.

is made for use in any of the numerous shapes and positions demanded by the trade. The makers claim it to be absolutely water-tight, each fixture being thoroughly tested before leaving their works.

By consulting the accompanying cuts a clear conception of the above features may be obtained. In Fig. 1 is shown a type A fixture in section as used for pendants on conduit work.

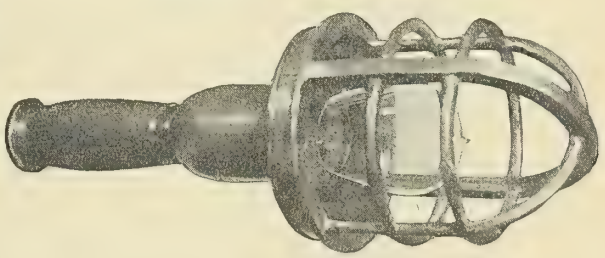


FIG. 2.

The bell-shaped shell *B* completely surrounds the socket *A*.

The socket is connected to the shell by the threaded nipple *C*, which is held firmly in place by the screw *D*. An elastic packing *E* is clamped securely to the bottom of the flange of the shell by the adjustable packing ring *F*. An opening is cut in the center of the elastic packing, just large enough to allow the base of a lamp to pass through snugly. As the lamp is screwed into the socket, the internal pliable edge of the packing grips the neck of the lamp firmly, at the same time adjusting itself

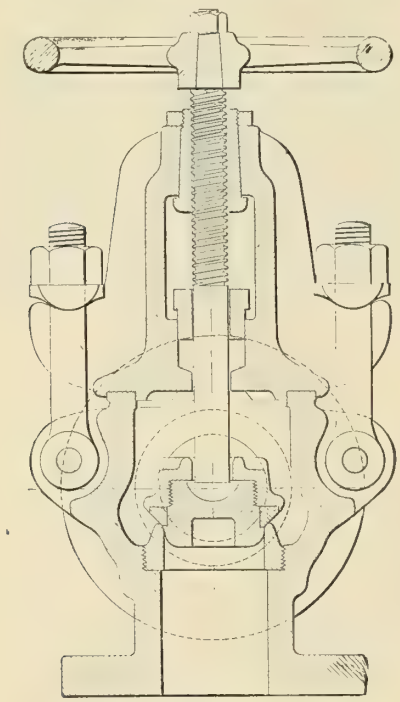
to any irregularity in the structure of the lamp, thus making a water-tight joint.

Fig. 2 shows the type A portable fixture, which is fitted with a hardwood handle, and a stuffing box with the standard stuffing rubber to make a tight joint with the cable.

Both the above type fixtures are fitted with standard keyless sockets of Edison, T. H., or Westinghouse type.

Heavy Blow-off Valves.

The valves here illustrated are suitable for blow-off valves on high-pressure boilers, and are designed for a working steam pressure of 250 pounds per square inch, having a factor of safety amply large to cover the stresses due to such service. They are made from extra



SECTION OF A HEAVY BLOW-OFF VALVE.

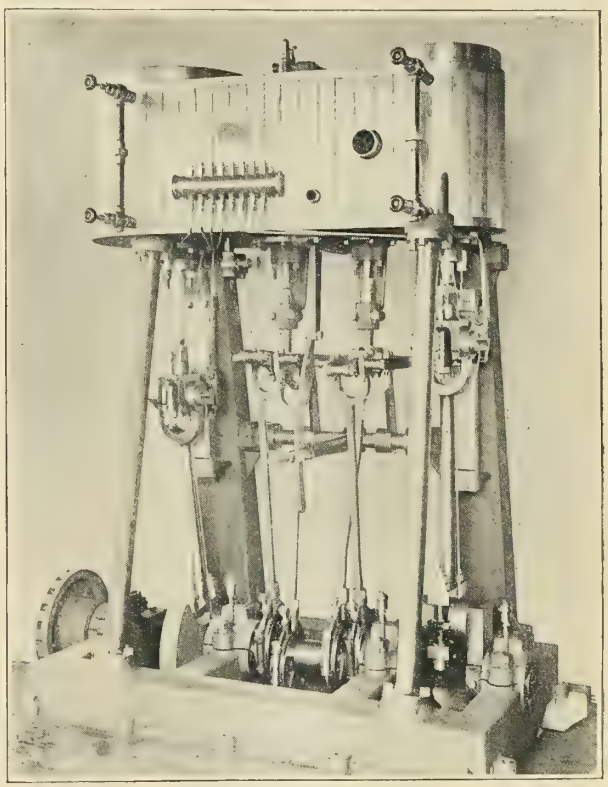
heavy patterns, have iron bodies, caps, and wheels, renewable bronze seat rings, bronze spindles with outside screw, and the self-packing feature enables them to be packed while open. The valve disc has a renewable soft metal ring, which can be easily changed by removing the piston portion of the valve disc. These soft metal rings are cast in a metal mold and require no finish.

The bronze seat rings can be easily taken out of the body and refaced, in case they become worn or injured. The body and cap joints of these valves are made with flanged, tongued, and grooved joints, held together by two large swivel eye bolts made fast to the body of the valve, thus forming a very reliable method of making body and cap joints tight, and permitting them to be easily taken apart to renew the valve seats. These valves are made with flanged ends, and are fitted with bolt following stuffing box packed ready for use. Further particulars should be addressed to the manufacturer, The Chapman Valve Manufacturing Company, Indian Orchard, Mass.

Compound Marine Engine.

A compound marine engine has recently been built by Jas. H. Paine and Son, Boston, Mass., for the Damariscotta Steamboat Company, and of which a brief description follows.

The engine is a fore and aft compound, having cylinders 10 inches and 20 inches diameter with a stroke of 14 inches. The steam chests, which are steam jacketed, are both between the cylinders, with faces bolted together, thus forming but one chest which contains both valves with suitable partitions between. Piston valves are used in both, with the H. P. taking steam in the center and exhausting over the ends into the L. P. chest or receiver, from which the L. P. valve takes steam over



COMPOUND MARINE ENGINE.

the ends and exhausts in the center. This arrangement of cylinders obviates the use of the usual long outside receiver pipe and also does away with the overhung and unsupported steam chests, and enables the engine to be placed close to the aft bulkhead, as there are no parts here which require access.

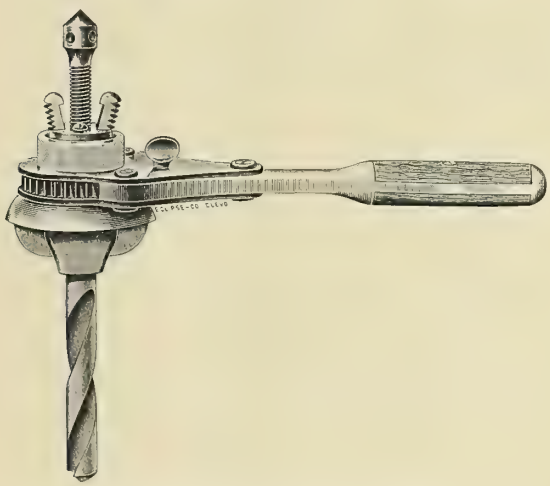
It was also wished to increase the length of the main journal bearings and crank pins with the same over all length of engine. The main journal bearings were thus increased 5 per cent. and the crank pins 10 per cent., and the same over all length retained.

The front of the engine is made open, there being but the two straight columns, so that all parts are directly under the eye of the engineer, and all bearings are within reach. The main steam and by-pass are placed close together, so that there is no reaching for steam valves. The crosshead is of bronze with wrist box inserted, while the crosshead guide is of cast iron and of the

single bar type, secured to the back frame, so as to be taken down without removing crosshead or connecting rod. The links are of the double bar type, and the valve gear is adjustable in all its parts. The reverse shaft is placed between the back frames, which brings it entirely out of the way. The oiling service is very complete, and consists of oil boxes cast on main journal caps and fitted with hinged covers; grease caps also are fitted. Crank and wrist pins and slides are supplied from a large brass tank with needle valves, sight feeds and tubes. Valves are so arranged that the feed being once set they can be closed and opened without further adjusting.

Following are some of the principal dimensions:

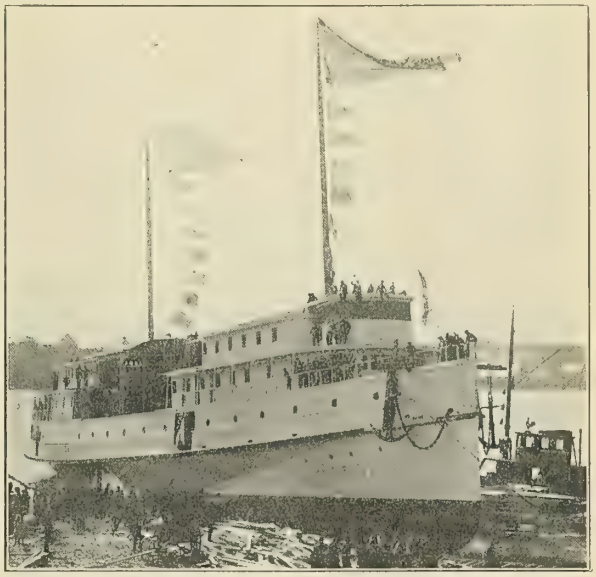
Length from face of coupling to forward end of crank shaft	71 in.
Length over cylinders	60 in.
Extreme width of bed plate	44 in.
From center of shaft to top of engine	79 in.
Diameter of main journals	4 in.
Diameter of crank pins	4 in.
Length of crank pins	6½ in.
Length of connecting rod, between centers	35 in.
Diameter of crosshead pin	2½ in.
Length of crosshead pin	4½ in.
Weight of engine	5,500 lbs.



COMBINED RATCHET WRENCH AND DRILL.

Ratchet Wrench and Drill.

The accompanying illustration of the Universal ratchet wrench shows a most convenient and useful tool. The tool is a fairly well equipped tool chest in itself and enables one to get at bolts, nuts, set caps and lag screws with extraordinary ease and dispatch. For overhead work and inclosed places it is particularly adapted, as it only requires a play of one inch to effectually operate. It is reversible and can be adjusted with great ease to take nuts of any size up to two inches diameter. All parts are made of material best suited to meet the severe requirements, and the wearing parts are hardened. It is light in weight, highly finished, and all parts are interchangeable. When it is desired to be used as a drill the drill and feed screw are attached, as shown, forming a very compact tool. This wrench is made by the Universal Manufacturing Company, 22 China street, Cleveland, Ohio.



LAUNCH OF THE RANSOM B. FULLER.

LAUNCHES.

Steamer City of Haverhill.—There was recently launched from the Atlantic Works, East Boston, Mass., the wooden steamer *City of Haverhill* for service between Boston and Haverhill, to carry both passengers and freight. The hull is 135 feet long, 25 feet broad and 8 feet deep, and was designed by Wm. T. and Richard Keough, of Boston. The vessel is to be driven by one set of compound engines with cylinders 12 and 28 inches in diameter by 20 inches stroke. Two water-tube boilers with 54 square feet of grate surface supply steam at 200 pounds pressure. The builders are Burtison and Paterson.

Tug John G. Chandler.—The tug *John G. Chandler,* built for the Commercial Tow Boat Company, of Boston, was launched from the yard of Kelley, Spear and Company, Bath, Me., on April 28. The vessel measures 102 feet in length, 20 feet in width and 11 feet 4 inches in depth, and is propelled by a compound engine. The tug will cost about $40,000, and was designed by Messrs. William and Richard Keough, of East Boston, Mass. The machinery, built by the Bath Iron Works, consists of a compound engine with cylinders 15 and 34 inches in diameter and 24 inches stroke, and a return tubular boiler.

Steamboat R. B. Fuller.—There was recently launched for the Eastern Steamship Company the steamer *Ransom B. Fuller,* built by the New England Shipbuilding Company, Bath, Me. As will be seen from the illustration, the *Fuller* is a side-wheel vessel built of wood. She is of the following dimensions: Length over all, 294 feet; beam, 40 feet; depth, 14 feet; draft, 8½ feet. The machinery consists of a low-pressure beam engine, with cylinder 63 inches diameter and 11 feet stroke, supplied with steam at 52 pounds pressure by two boilers. The paddle wheels are 27 feet in diameter and 10 feet face, and are fitted with feathering buckets which are 4 feet in width. The vessel was designed by Mr. Fred W. Rideout.

Yacht Chanticleer.—The schooner yacht *Chanticleer* was launched on April 10 at Morris Heights, New York city. It measures 118 feet over all, 70 feet on the water line, 22 feet beam, and 12 feet 6 inches depth, and will be owned by Mr. Geo. W. Wells, of Boston.

Steamer Tremont.—On May 7 the Maryland Steel Company launched from its marine works at Sparrows Point, Md., the steamship *Tremont* for the Boston Steamship Company. This vessel is a sister ship to the *Shawmut,* which was launched last winter, and which was described in Marine Engineering of January, 1902.

Steamship Nebraskan.—The steamship *Nebraskan,* for service in the American-Hawaiian Steamship Company, was launched from the yards of the New York Shipbuilding Company on May 19. The ship is 271 feet long, 46 feet beam, with a depth to the shelter deck of 34 feet 8 inches, and her boilers are equipped with oil burners.

Yacht Majorie.—The schooner yacht *Majorie,* built by Robert Jacob, City Island, N. Y., from designs by H. C. Wintringham, for Frank L. St. John, was successfully launched from City Island on April 5. The *Majorie* is a schooner yacht and her dimensions are: 89 feet over all, 62 feet on the water line, 18 feet beam, and 8 feet depth.

Steamer Ventura.—The freight and live-stock carrying steamer *Ventura,* built at the Victoria Machinery Depot, Victoria, B. C., for N. P. Shore and Company, of that city, was launched on May 5. The vessel is 160 feet long, 38 feet beam, and 11 feet deep, and is intended for the Skagway and Yukon River trade, and will be propelled by twin screws.

Destroyer Stewart.—On May 10 the U. S. torpedo boat destroyer *Stewart* was launched from the yard of the Gas Engine and Power Company and Chas. L. Seabury and Company, Consolidated, Morris Heights, New York. The length of the vessel along the load water line is 254 feet; beam, 23 feet; and the displacement, about 420 tons. Preliminary trials will be started in about two months, and it is expected that the vessel will probably be ready for commission in October.

Steamer Hermosa.—Wm. Miller recently launched from his shipyard at Mormon Island, near San Pedro, Cal., the passenger steamer *Hermosa,* which is of the following dimensions: Length over all, 150 feet; breadth, 28 feet; depth, molded, 13 feet 10 inches. The boat is owned by the Wilmington Transportation Company and is driven by one set of triple expansion engines. The furnaces of the boilers are equipped with oil burners.

Steamship James Gayley.—The freight steamship *James Gayley* was launched from the American Shipbuilding Company's yard at Cleveland, Ohio, on March 29. The vessel is 436 feet over all, 420 feet keel, 50 feet beam, 28 feet deep. Steam will be furnished by two Scotch boilers 13 feet 7 inches in diameter and 11 feet 6 inches long, to be allowed 170 pounds pressure and fitted with the Ellis and Eaves system of induced draft. The engine will be triple expansion with cylinders 22, 35 and 58 inches in diameter by 40 inches stroke. The vessel is building for the Cleveland Steamship Company.

Steamer Chas. Beatty.—The Craig Shipbuilding Company, Toledo, Ohio, recently completed the steamer *Chas. Beatty,* built for the lumber trade between Mackinac and Tonawanda. The vessel is 225 feet long, 40 feet beam, 16 feet deep and has a capacity of about one million feet of lumber.

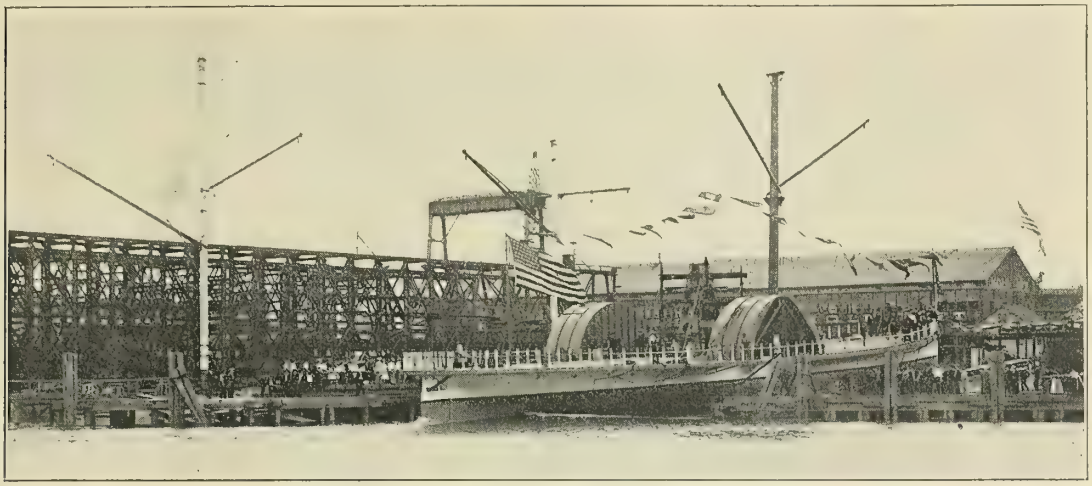
Tug John A. Hughes.—On May 14 the tug *John A. Hughes* was launched from John A. Dialogue and Son's shipyard, Kaighn's Point, Camden, N. J. The vessel was built to the order of Albert and James Hughes, of Philadelphia, and is 100 feet long, 20 1-2 feet beam, and 12 feet 3 inches deep. She is provided with wrecking pumps besides the usual instalment of auxiliaries.

J. M. Jenks.—The third vessel of the steamers built for Messrs. Howgood and Company, of Cleveland, the *J. M. Jenks,* was launched on May 16 in the Lorain yards of the American Shipbuilding Co. The vessel is 434 feet over all, 50 feet beam and 28 feet deep. She will have triple-expansion engines with cylinders 22, 35, and 58 inches in diameter by 40 inches stroke. There are two Scotch boilers fitted with Ellis and Eaves induced draft.

Pilot Boat New Jersey.—A handsome pilot boat for the New York and New Jersey Sandy Hook Pilots' Association was launched from the yards of A. C. Brown and Sons, Tottenville, Staten Island, on March 28, and christened the *New Jersey.* The vessel is of oak, 155 feet long, 29 feet beam, 18 feet deep, and will be supplied with triple-expansion engines of 650 horse power. The vessel will be comfortably fitted out for the accommodation of the pilots, and she will cost about $90,000.

Tug Sea Rover.—From the Fulton Engineering Works at Harbor View, San Francisco, Cal., there was launched on March 8 the steel tug *Sea Rover,* built to the order of the Ship Owners' and Merchants' Towboat Company. Her length over all is 128 feet; perpendicular length, 120 feet; beam, molded, 24 feet 6 inches; and depth, molded, 15 feet. The machinery consists of a compound engine with cylinders 17 and 41 inches in diameter by 28 inches stroke, and the boiler is 10 feet 6 inches in diameter, 16 feet 10 inches long, and is to burn oil fuel. The fuel tanks have a capacity of 50,000 gallons of oil.

Steam Yacht Aztec.—One of the largest pleasure vessels ever built in America, the steam yacht *Aztec,* was launched from the Crescent Shipyard, Elizabethport, N. J., on April 22. The *Aztec* was built from designs and under the supervision of Messrs. Gardner and Cox, and is owned by Mr. A. C. Burage, of Boston. The general dimensions are: Length over all, 250 feet; on water line, 215 feet; breadth, 30 feet; depth, 22 feet 6 inches; draft 13 feet 3 inches. She is built entirely of steel with transverse water-tight bulkheads and double bottom. The vessel was designed for deep sea cruising and has a steaming radius of 6,000 miles at a speed of 12 knots. There are two 4-cylinder triple expansion engines with cylinders 18, 25, 33 and 33 inches in diameter by 34 inches stroke, and at 200 revolutions are designed to indicate 2,500 horse power. Two Scotch boilers, built by the Cleveland Shipbuilding Company, furnish steam at 200 pounds pressure. The speed of the *Aztec* is expected to be 14 knots under natural and 16 knots under forced draft.



LAUNCHING THE MARYLAND AT WILMINGTON, DEL.

Yacht Celt.—The steam yacht *Celt,* designed by Mr. H. C. Wintringham for Mr. J. Rogers Maxwell, New York, was launched on April 12 from the yard of the Pusey and Jones Company, Wilmington, Del. The *Celt* is 170 feet long over all, 138 feet 6 inches on the water line, 23 feet 6 inches beam and 12 feet 6 inches in depth.

Steam Yacht Margaret.—On April 8 the steam yacht *Margaret* was successfully launched from the yard of the Gas Engine and Power Company and Chas. L. Seabury and Company, Consolidated, Morris Heights, New York city. The yacht is built for John H. Rutherford, of New York, for service on Lake Champlain and the Great Lakes, and the peculiar feature of the boat is that the bow and stern are detachable, so that the over all length may be diminished from 120 to 98 feet, in order that the vessel may pass through the canal.

Steam Yacht Jule.—On May 7 the steam yacht *Jule* was launched from Morris Heights yard, New York city. The vessel is built for Mr. Alfred Costello, of this city, and is for service on the St. Lawrence. The general dimensions are: Length over all, 85 feet; length on water line, 75 feet; beam, 12 feet 6 inches; draft, 4 feet 6 inches. The engine is the Seabury triple expansion of the latest type, with cylinders 7, 11 1-4, and 17 inches in diameter by 10 inches stroke. Seabury boilers supply steam.

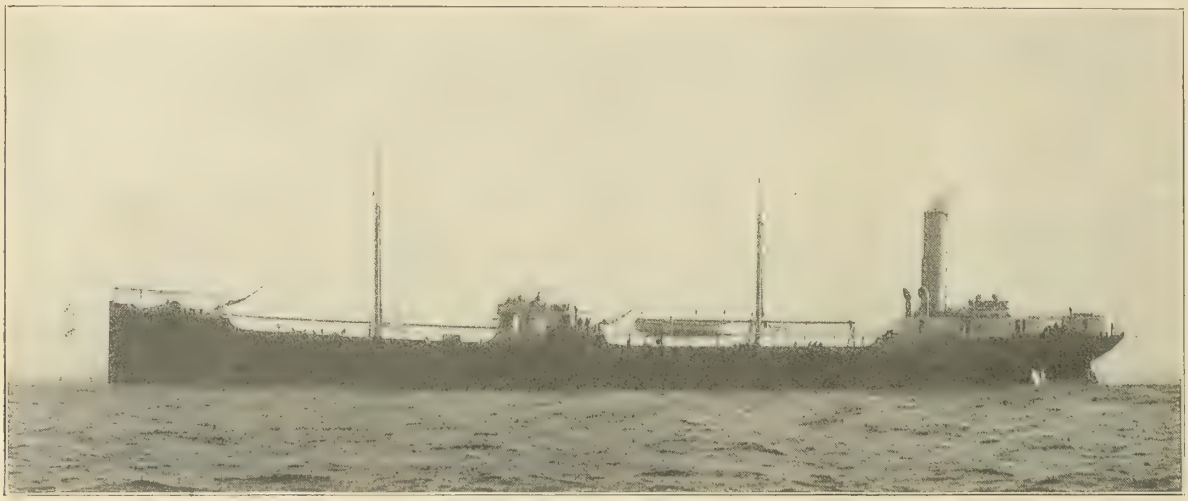
Russian Training Ship.—There was recently added to the Russian Navy the training ship *Okean,* of about 12,000 tons, 18 knots speed, which was built by the Howald Works at Kiel. The principal dimensions are: Length over all, 470 feet; beam, 58 feet; draft, 25½ feet. The *Okean* is the first war vessel which has been designed to serve the double purpose of transport and training ship. In the first-named capacity she will be used on the Pacific coast, and as a training ship will be used mainly for the instruction of engineers and stokers. Her crew consists of 25 officers and engineer instructors and 700 men. Her engines indicate about 11,000 horse power, and for purposes of instruction not less than four types of water-tube boilers have been installed, namely, six Bellville, six Niclausse, one Yarrow, and one Thornycroft.

Steam Yacht Pantooset.—On March 10 the steam yacht *Pantooset* was launched from the yards of the Bath Iron Works, Bath, Me., built to the order of Commodore A. S. Bigelow, Boston. The yacht is 212 feet 6 inches over all, 27 feet 2 inches beam, 16 feet 6 inches deep.

Steam Yacht Vixon.—The new yacht *Vixon,* built at Morris Heights, New York, for John D. Archibald, was launched on April 23. The dimensions of the boat are 100 feet over all, 12 feet beam and 5 feet draft. The yacht is designed to make high speed and is propelled by two sets of triple expansion Seabury engines furnished with steam at 250 pounds pressure by a Seabury water-tube boiler.

Steam Yacht Hauoli.—On May 31 there was launched from J. N. Robbins' yard, Erie Basin, Brooklyn, the steel steam yacht *Hauoli,* owned by Mr. F. M. Smith, of San Francisco, and designed by Mr. Henry J. Gielow, of New York. The principal dimensions of this vessel are: Length over all, 153 feet 7 inches; on water line, 122 feet 9 inches; beam, extreme, 17 feet 6 inches; depth, 9 feet 8 inches. There are two mahogany deck houses, the forward one containing the dining saloon and the after one the social hall. The engine is of the four-cylinder, triple-expansion type, and steam is supplied by two water-tube boilers of 250 pounds pressure. Under natural draft it is estimated that the vessel will steam at 17 1-2 miles.

Steamboat Maryland.—The side-wheel steamboat *Maryland,* building for the Baltimore, Chesapeake and Atlantic Railway Company at the yard of the Harlan and Hollingsworth Company, Wilmington, Del., was launched on May 24. The vessel is to ply on the Chesapeake Bay and tributaries, and is fitted for service of night boat, with passenger sleeping accommodations for 200. The vessel is 180 feet long between perpendiculars; 34 feet beam, molded; 55 feet 6 inches over guards; 10 feet 1 inch molded depth. Her motive power consists of a vertical surface condensing beam engine with cylinder 38 inches in diameter by 9 feet stroke, and with Stevens cut-off proportioned for 60 pounds pressure. Her speed is to be 15 miles per hour.



BRITISH TANK STEAMER KINSMAN, RECENTLY LAUNCHED.

Auxiliary Yacht Ariadne.—The steel, schooner-rigged, auxiliary steam yacht building for Mr. Henry W. Putnam, Jr., New York city, from designs furnished by Messrs. Tams, Lemoine and Crane, was launched at the yards of Harlan and Hollingsworth Company, Wilmington, Del., on May 22, and christened the *Ariadne*. The dimensions of the yacht are: Length on deck, about 131 feet; length on load water line, 110 feet; extreme beam, 26 feet; depth amidships on center line, 19 feet; draft, aft, 14 feet. The motive power consists of a 2-cylinder compound engine, supplied with steam from two Almy watertube boilers at 250 pounds pressure.

Torpedo Boat Hopkins.—On April 24 the Harlan and Hollingsworth Company, of Wilmington, Del., launched the torpedo boat destroyer *Hopkins*, known as Number 6. The *Hopkins* is a sister boat to the *Hull*, building by the same company, and is of the following dimensions: Length, 245 feet; extreme breadth, 23 feet; draft, 6 feet 6 inches; corresponding displacement, 408 tons. Four Thornycroft water tube boilers will furnish steam at 300 pounds pressure to the twin screw, vertical, four-cylinder, triple expansion engines with cylinders 20 1-2, 32, 38 and 38 inches in diameter by 22 inches stroke, designed to indicate about 8,000 horse power. The guaranteed speed is 29 knots.

Hamburg-American Liner Moltke.—The most recent addition to the Hamburg-American line is the steamship *Moltke* which arrived in New York March 20. The *Moltke* is a sister ship to the *Blücher* and is of the intermediate type of passenger and freight steamer. The vessels are 525 feet long, 62 feet wide, 45 feet deep and are equipped with two sets of quadruple expansion engines developing 8,000 horse power and giving a speed of 16 knots. The accommodations for the first-class passengers are located on five decks amidships. On the boat deck is a gymnasium and grill room, on the promenade are drawing room, smoking room and many fine staterooms. On the saloon deck is the dining saloon, with a seating capacity of 225, and many more fine cabins. The upper and main decks are devoted entirely to staterooms.

Turbine Yacht.—A very fast yacht, built to the order of Colonel McCalmont from designs prepared by Messrs. Cox and King, was launched on May 24 from the yard of Messrs. Yarrow and Company, Poplar. This yacht is of very special design, being built on the lines customary with vessels of the torpedo-boat class and provided with turbine engines constructed by Messrs. Parsons, fitted with three shafts and three propellers on each shaft. As regards the hull and boilers, the yacht is identically similar to a first-class torpedo boat, the boilers being of the Yarrow type; therefore the trials will be watched with interest, as forming a fair comparison with those of similar vessels provided with boilers of this class but fitted with reciprocating engines, the machinery being the only portion of the vessel in which it differs from a Yarrow first-class torpedo boat.

Petroleum Steamer Kinsman.—The latest addition to the large fleet of oil-carrying steamers built at the Walker shipyard of Messrs. Armstrong, Whitworth and Company, Limited, is the *Kinsman*, which was launched last October and is here illustrated. The vessel has been built to the order of the Bear Creek Oil and Shipping Co., Ltd., Liverpool, and is of the following principal dimensions: Length, 373 feet; breadth, 49 feet 9 inches; depth molded to upper deck, 30 feet 3 inches. She is capable of carrying 6,500 tons on a moderate draft of water. The vessel has a poop, bridge, and topgallant forecastle, and is rigged as a two-masted fore-and-aft schooner. The accommodation for the captain and officers is in the bridge, for the engineers in the after end of the poop, and the seamen and firemen will be berthed in the forecastle. The vessel is built of steel under special survey for Lloyd's highest classifications. The vessel has large cargo hatches to enable her to carry general cargo, should it be so desired. Complete pumping and piping installations for dealing with the liquid cargo have been fitted, and electric light supplied throughout the ship. The *Kinsman* is fitted with triple-expansion machinery manufactured by the Wallsend Slipway and Engineering Company, Limited.

TECHNICAL PUBLICATIONS.

The Balancing of Engines, by W. E. Dalby. Size 5½ by 9. Pages 283, with 173 diagrams in the text. Price $3.75. Longmans, Green & Co., London and New York.

This book appears at an opportune time, when the balancing of engines, both locomotive and marine as well as stationary, is attracting an increasing amount of attention. During the last ten years this subject has forced itself strongly upon the attention of marine engineers, and at the present time in all careful designs, and especially where high speed conditions are involved, the question of engine balance is one which must receive due attention. The purpose of this book seems to be the development of a semi-graphical method which may be used for the investigation of the various problems which arise in connection with the balancing of engines of any and all types. From the nature of the problem and of the method proposed, the writer finds it necessary to begin the discussion of the subject with a chapter on "Vector Quantities" and their addition and subtraction. Following this he discusses in chapter ii. the balancing of revolving masses, and in chapter iii. the balancing of reciprocating masses, when the effect due to the angularity of the connecting rod is considered unimportant. This is followed in chapter iv. with a general discussion of the balancing of locomotives, with illustrations from English and American practice. In chapter v. the author discusses the influence due to the angularity of the connecting rod, and shows the amount of error involved in omitting forces beyond those of the second order. Both analytical and graphical methods are given for the determination of the acceleration involving the angularity of the connecting rod, and illustrations are given of the application of the method to engines having one, two, three, four, five, and six cranks. In chapter vi. the same subject is extended by the introduction of additional practical methods and by discussion of the influence due to valve gear and suitable methods for its determination. In chapter vii. the subject of vibration is discussed in a simple manner, especially as manifested under the influence of such forces as are developed by an unbalanced marine engine. The last chapter is devoted to a general discussion of the connectinng-rod problem, the purpose of the discussion being a more detailed examination of the forces due to the connecting rod which act at its upper and lower ends. The character of these forces is discussed, and the equations developed are illustrated by diagrams and other illustrative matter.

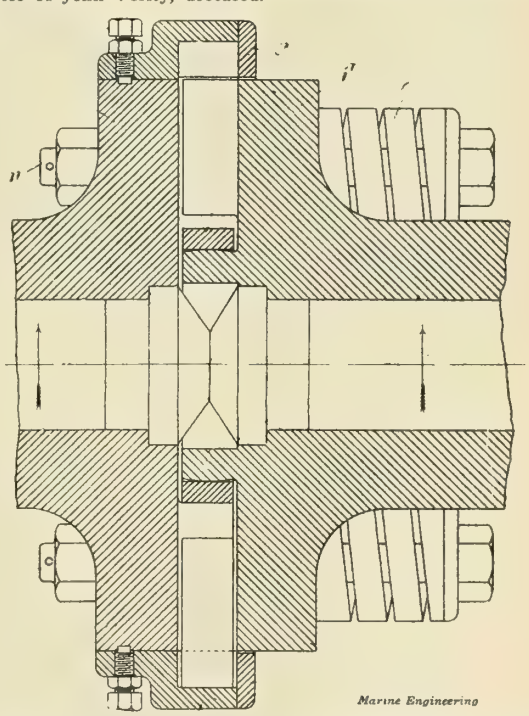
Taken as a whole, this book forms a most acceptable and valuable contribution to the literature of this subject. It is an interesting commentary on the increasing importance of this topic that a few years ago the entire literature consisted of a few papers scattered here and there in the transactions of engineering societies, while at the present time its importance is such as to justify the author in the preparation of a book entirely devoted to this subject. Outside of the intrinsic value of the book itself, which is great, one of its most valuable features lies in the fact that it gathers together in one publication the leading features of the entire problem, and gives methods suitable for its investigation, thus saving the student from the expenditure of the large amount of time and energy needed to examine th various original papers for himself. To all marine engineers and designers who are concerned with the problem of the balancing of engines we would cordially commend this work as providing a sufficiently complete discussion of the subject for all practical purposes, together with such practical methods of investigation and determination as have proved themselves valuable in actual experience with such problems.

Beeson's Marine Directory, 1902. Harvey C. Beeson, 360 Dearborn street, Chicago, Ill. One vol., 258 pp., 6½ by 9½ in. Price, $5.

The fifteenth annual edition of the Beeson's Marine Directory of the Northwest Lakes for 1902 has just been issued. Among the leading features are lists of steam and sailing vessels on the Lakes; the names of the owners of the Lake vessels; the records of engines and boilers on Lake vessels; lists of Canadian vessels on inland waters; vessels whose names have been changed; records of marine disasters; ore docks; classified trade directory of firms and companies connected with Lake maritime industries. The distinctive feature of this year's book is the list of iron ore carriers, with cargo capacity of each on a given draft, and also about twenty pages devoted to important decisions in Admiralty cases that should be of interest to Lake navigators. Many articles appear on subjects of general maritime interest, and the volume is well illustrated with many views of vessels of all classes. It is well printed on heavy paper and strongly bound in cloth.

SELECTED MARINE PATENTS.

699,356. COUPLING FOR SHIPS' PROPELLER SHAFTS. WILLIAM W. WHITE, NEW YORK, N. Y., ancillary executor of John Verity, deceased.

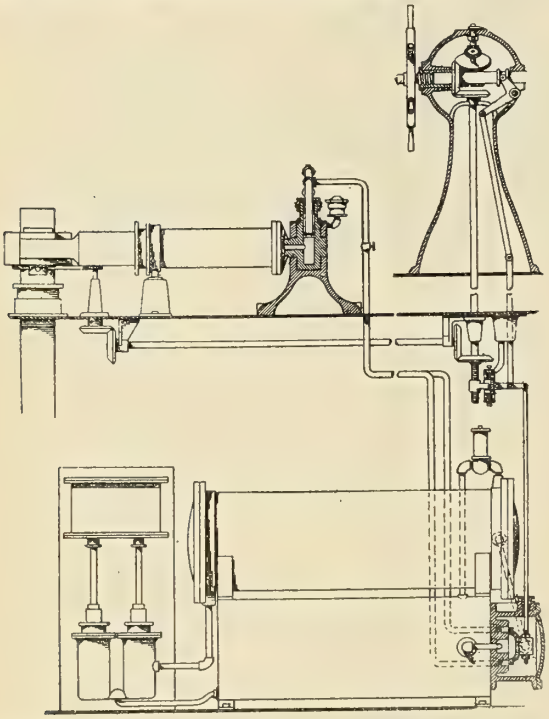


CLAIM.—1. In a ship's propeller-shaft comprising a plurality of lengths, a length of shafting having a coupling-flange x at each end, and between these ends a flexible device consisting of a flange i on one part of the shaft with projections j on its inner face, a flange i' on the other part having projections j on its inner

face, adapted to fit in the spaces between the projections j of the other flange, oppositely-disposed bearing-heads z, with shoulders z' fitting in and supported in the ends of said shaft, and inwardly-tapering bearing-faces; keys p fitting between two of the adjacent faces or edges of the projecting parts j, wedges q disposed between the other adjacent edges of said parts j, a wedge-holding cam-ring s fitting over the flanges ii', having cam-recesses t in which the ends of the wedges q work, a projecting annular flange or ring k on the flange i, and a ring r fitting outside and on the ring k, and supporting the inner ends of the keys p, and a plurality of bolts n and springs o, said bolts passing through said flanges i and parts j. Three claims.

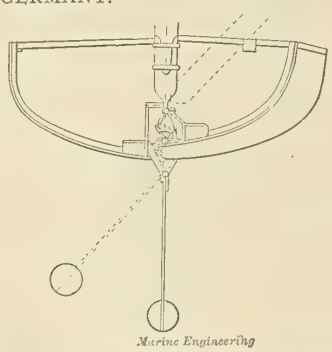
699,450. DEVICE FOR CORRECTING COMPASS ERRORS. JORGEN CHRISTENSEN, SAN FRANCISCO, CAL. Five claims.

699,451. HYDRAULIC STEERING MECHANISM. JORGEN CHRISTENSEN, SAN FRANCISCO, CAL.



CLAIM.—1. The combination in a steering mechanism of oscillating hydraulic cylinders, having connection through their pivot ends with a source of fluid-supply, and means connecting the cylinders whereby the fluid may flow from one cylinder to the other, pistons reciprocable within said cylinders, piston-rods connected with the stock of the rudder, means for controlling the flow to and from said cylinders whereby the pistons are actuated to move the rudder, and means upon the rudder-stock whereby said flow may be automatically checked when the rudder has swung a certain distance in either direction. Sixteen claims.

700,011. BOAT OR VESSEL. JULIUS F. BECKER, HAMBURG, GERMANY.

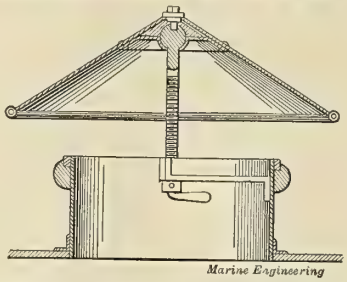


Marine Engineering

CLAIM.—In a ship, boat, or other vessel, the combination of a hinged mast, a toothed segment rigidly secured to said mast below the hinge, a shaft, a second toothed segment secured on said shaft and meshing with the segment secured to the mast, a third toothed segment secured to said shaft, a lever carrying a weight, a fourth toothed segment, secured to said lever, substantially as, and for the purpose, set forth.

700,012. PROTECTIVE TUMBLING-HOOD FOR SHIPS' HATCHES. JOHN BERGESEN, NEW YORK, N. Y.

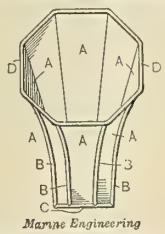
CLAIM.—1. The combination with an inwardly-projecting arm secured to the upper end of the article to be protected and provided with a nut at its free inner end, of a screw-threaded rod screwing into the nut of the arm and provided with a ball at its upper end, and a conical hood having a socket on its inner face at the apex to receive the ball of the rod, said hood



Marine Engineering

being of a diameter considerably greater than that of the article and adapted to be seated on the upper edge of same, as set forth. Two claims.

699,928. SHIP'S VENTILATOR. CHARLES McVEETY AND JOHN F. FORD, PHILADELPHIA, PA.



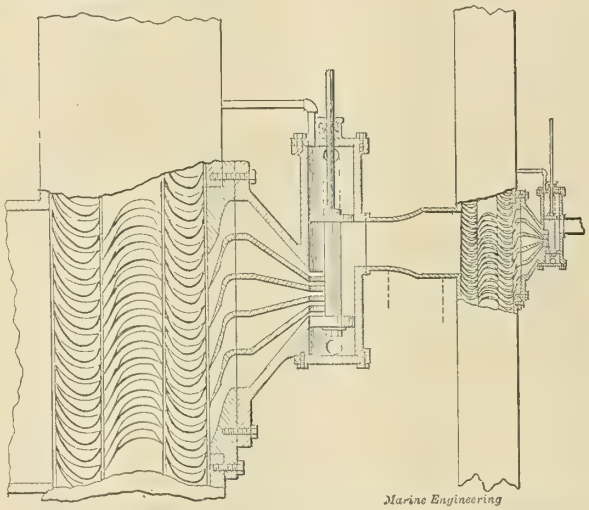
Marine Engineering

CLAIM.—2. A ventilator comprising a curved tapered pipe octagonal in cross section, composed of plates A, having upturned end forming grooves, ribs B in the form of split tubes for engaging and holding said plates in position, and ribs C and D arranged respectively at the base and mouth of the ventilator, having slotted openings to receive the plates and openings for the ribs, substantially as specified. Two claims.

700,278. REVERSIBLE SCREW-PROPELLER. LIDA WILSON, BROOKLYN, N. Y. Eight claims.

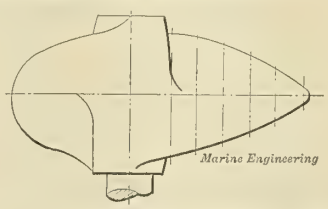
700,280. APPARATUS FOR UNLOADING VESSELS. CYRUS H. WOODRUFF, BUFFALO, N. Y. Three claims.

700,314. STEAM-TURBINE. JOHN H. FEDELER, NEW YORK, N. Y. Five claims.



Marine Engineering

700,365. SCREW-PROPELLER. CHARLES A. PARSONS, NEWCASTLE-UPON-TYNE, ENGLAND.



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CLAIM.—1. A screw-propeller provided with blades constructed with a reduced pitch toward their tips, the reduction commencing from about one-half to two-thirds outward from the blade-roots.

2. A screw-propeller having vanes secured to the propeller-cone behind the blades. Two claims.